APPLEBYS'

ILLUSTRATED HAND-BOOK

OF

MACHINERY AND IRON WORK,

WITH THE

Cost, the Working Expenses, and Results Obtained,

IN THE USE OF

STEAM AND HAND CRANES, PUMPS, FIXED AND PORTABLE STEAM ENGINES,

AND VARIOUS OTHER MACHINES, WITH WEIGHTS, MEASUREMENTS, ETC.

ALSO,

PRICES OF TOOLS, IRON WORK, STORES, AND MATERIALS,

Required by Civil and Mechanical Engineers, Merchants, and others.

TOGETHER WITH NUMEROUS TABLES, AND MEMORANDA.

BY

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PREFACE

TO THE SECOND EDITION.

THE favourable reception of the First Edition of the "HANDBOOK OF MACHINERY AND IRON WORK," evinced by the rapid sale and subsequent inquiry for it (when it had been long out of print), has induced the Authors to prepare a Second Edition of their work; and in doing so it has been their endeavour, whilst omitting some of the matter which the rapid progress of mechanical science has rendered obsolete, to increase its usefulness by adding a very considerable amount of information, accumulated in the interval between the former and the present Edition. In order to make it as far as possible a reliable book of reference for engineers in making their calculations for work to be executed, and to enable merchants and others interested in mechanical matters, to arrive at an approximate estimate of the cost of machines and materials of ascertained quality which they may require, the Authors have for the most part tested in actual work those illustrated and described, and in many instances the name of the manufacturer is supplied, whilst the prices of materials, stores, &c. are those which have been satisfactorily adopted in their own practice for several years. Although there is a considerable amount of original matter in the following pages, much has been collected from a variety of sources, and the object has been to arrange the whole in a compact form, with a copious Index, so that the information on the various subjects shall be available for ready reference for the purposes indicated.

There are so many admirable works devoted exclusively to engineering formulæ, that it has been thought desirable to give merely the tables constantly required in conjunction with the proportions of the machines in general use, and the prices of the several materials employed in their construction.

The Authors have to thank many of their friends whose kind assistance, always promptly rendered, has materially reduced their labour; and they have peculiar pleasure in expressing their high appreciation of the active co-operation of the members of their own staff, at a time when they were closely occupied by their ordinary duties

The quotation of prices is based upon the average market price of raw material, and any extraordinary fluctuation therein must affect the quotation for the finished article, but, practically, the prices quoted will be correct in all but exceptional cases.

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STEAM CRANES,

TRAVELLERS, WINCHES,

AND

STEAM HOISTING MACHINERY.

B

ON THE USE OF STEAM CRANES

AT THE

PORT OF BORDEAUX.

A PAPER on this subject was recently read before the Institution of Civil Engineers of France by M. Maldant, and after detailing the circumstances attending the selection of Cranes from fourteen or fifteen plans, based upon the application of steam and of water power, the writer states that ultimately steam-cranes were adopted, and that "the undertaking has proved so remunerative that it has left a "profit of rather more than 100,000 francs (£4,000) upon the five years' working, or "about 200 per cent. per annum on the capital laid out.

"The advantages of steam-cranes over hand-cranes can now be readily shown by "actual figures, taken from the accounts kept of the expenses of the steam-cranes "worked by the writer at Bordeaux. From these accounts it is found that the "average daily expenses of a 1½-ton steam-crane (1,500 kilogrammes), of two-horse "power, employed in the ordinary discharging of a merchant ship alongside the quay, "are 12 francs 80 centimes, or ten shillings and twopence halfpenny per day, which "is made up as follows:—

	fr.	c.		s.	d.
One Engineer	5	00	or	4	0
One Assistant	3	50	,,	2	9¼
Coal 60 kilos. (1·18 cwt.) at 40 francs per ton	2	40	,,	1	11
Repairs and maintenance, grease, &c.	0	90	,,	0	8½
Contingencies and redemption in twenty years	1	00	,,	0	9¼
Total expenses per working day	12	80		10	2¼

"The work done by the crane, if it were really made use of at all in proportion to "its power, might easily be as much as from 200 to 250 tons per day, which has to "be raised in loading or discharging to a mean height of about 8 metres (26 ft.); "but, practically, the work is scarcely more than from 100 to 120 tons discharged "per day, owing to the differences in weight of the various loads to be lifted, which "are often far below the weight for which the crane is calculated, and also owing to "all sorts of loss of time resulting from stowing the goods away in the ship's hold "or getting them out for discharging. Taking the lowest figure, only 100 tons raised "by the crane per day, the daily working expenses are then from 12 to 13 centimes "(1·2 to 1·3 pence) per ton of goods. By means of the above practical particulars, "any individual or company having goods of any description to load or unload can "easily estimate the work and the advantages that may be expected from the appli- "cation of steam-cranes to the purpose in view; for, in order to ascertain these "advantages, it is only necessary to add to the preceding information the rate of "profit that can be realized by the crane, and the quantity of work that can be given "it to do per day.

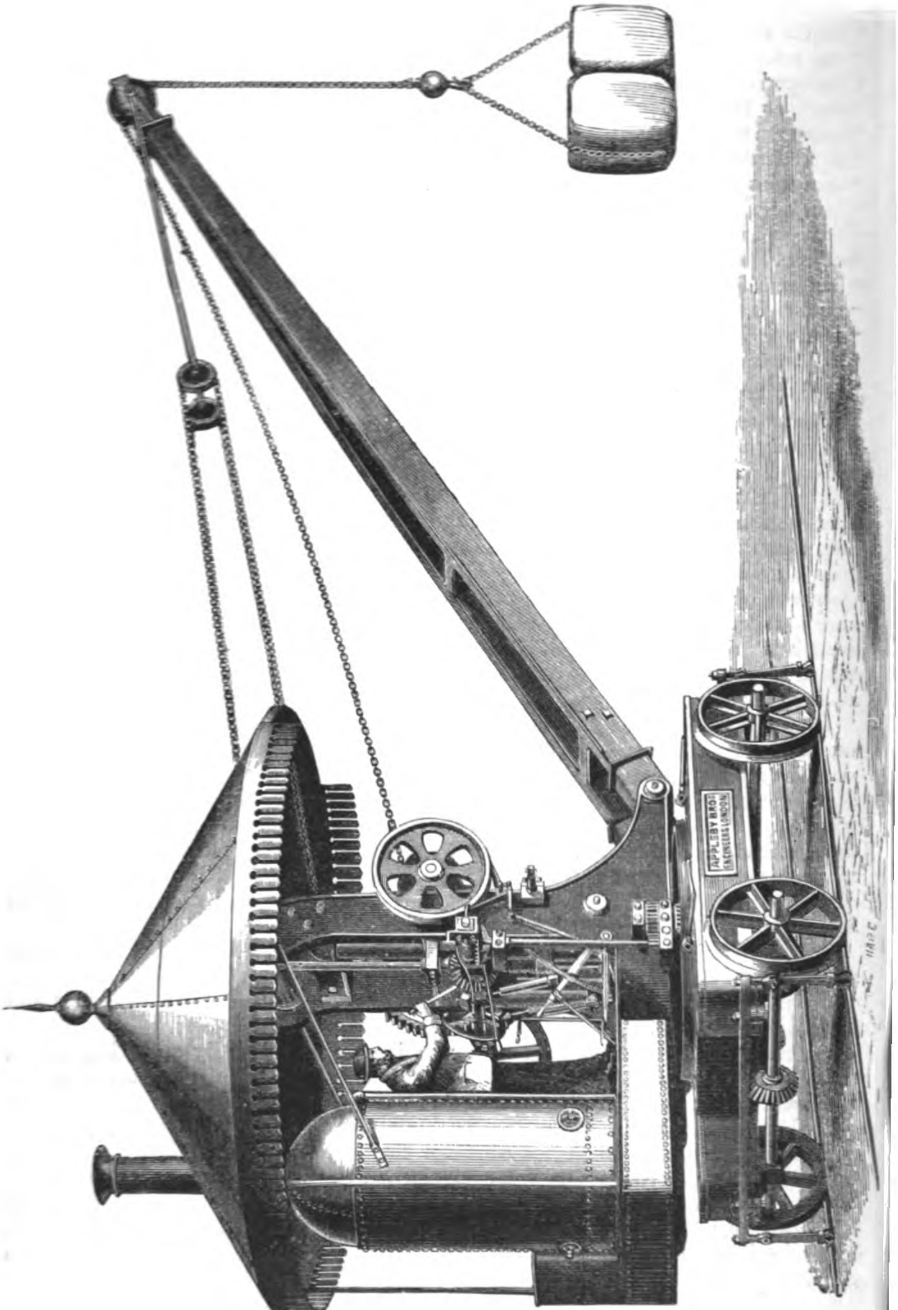
"It will readily be understood that the important advantage of steam-cranes "results from the great rapidity with which the load is lifted; for if the work of "one man turning a winch be taken equal to 6 kilogramme-metres per second (2,577 "foot-pounds per minute), a machine of two-horse power will perform as much lifting "work as twenty-five men, or about the same work as six hand-cranes worked by "four men each. In the presence of such manifestly satisfactory results, it is difficult "to understand why the use of steam-cranes is not more general. Moreover, steam-"cranes, as well as steam-winches employed on board ships, or in the erection of "buildings, and in mines, &c. have undergone recent improvements, whereby they "have been simplified, and rendered very moderate in price, and exceedingly easy "of use. The application of steam to the slewing or turning motion of the crane "has been found by the writer to be attended with inconveniences in practice which "outweigh its advantages; and, in some instances, it has been abandoned after "working for a few months or a few days only. In the construction of steam-cranes "and steam-winches the writer considers that simplicity of form and of mechanism "should be one of the most essential conditions to be kept in view."

Whilst agreeing generally in the foregoing remarks, it is evident that the writer is scarcely conversant with the most recent improvements in this class of machinery produced in England; so far from "the application of steam to the turning or slewing motion" being objectionable, precisely the reverse is found in practice. If this motion is "handy," as soon as the load is clear of the hatchway or other impediment, the radiating motion is thrown into gear, and the process of radiating goes on whilst the load is being lifted to the required height, and the entire operation of lifting and depositing the load in any desired position is performed by, and is under the perfect control of, the engine-driver, whilst *without this arrangement* it is evident that there is power lying dormant in the engine for an operation which must be performed by manual labour, and certainly the jib can be arrested at any desired point more perfectly by mechanism than by manual labour.

It would also appear that no provision was made in these cranes for giving a variable radius to the jibs, or for travelling by steam from one point to another. As vessels vary in beam according to their tonnage, if the crane has a derrick jib, the driver can plumb the centre of the hold, or drop the chain in any desired position, which will frequently enable him to reach packages which would otherwise have to be *moved up to the crane.* And with the steam travelling motion, the driver can move his crane to any point where its services may be required much more expeditiously, and at far less cost, than it can be moved (as is usual) by a gang of labourers.

The economical working results obtained from the arrangement of Machinery alluded to in the foregoing remarks has been amply tested in England, the Colonies, and various parts of Europe for some years past, and it is further described and illustrated at pages 9, 12, 13, 17, 22, 23.

Although the loads met with in discharging cargo are usually under half a ton, there are of course a large number above that weight; the horse-power of the Bordeaux cranes is probably sufficient for the work to be done there, but it is considerably below that found necessary in this country, and it is clear that as the same expense in attention is required whatever the weight lifted, the heavier the load the less will be the cost of lifting *at per ton*, and the authors' experience leads them to think that Portable Steam Cranes of the type used at the Paris Exhibition of 1867 (see pp.4-13) will be found more generally useful, as well as more durable and economical in working, than the lighter cranes described in M. Maldant's valuable paper.


APPLEBY BROS
ENGINEERS LONDON

STEAM CRANES.

The following illustrations have been selected from a large number of designs as being the most generally useful of the Cranes which have been constructed by the Authors; and, although there are considerable modifications in detail (as described with each engraving) the style of finish in all is in accordance with the subjoined general specification.

This Crane was designed and made by Appleby Brothers of London for Mr. Barnard, the Agent at Boulogne-sur-Mer of the South Eastern Railway Company, for discharging and loading the Folkestone and Boulogne boats; the working results are highly satisfactory in this as well as in many other instances where they have made similar Cranes for Railways, Dock Companies, &c. in England and abroad.

GENERAL DESCRIPTION.—The Crane is constructed to lift loads up to 1½ Tons at a maximum radius of 30 feet with a single chain, and weights up to 5 Tons at proportionately shorter radius,* and is fitted with steam radiating gear, steam derrick jib, which can be raised or lowered with or without the load, steam travelling motion to move the Crane along the rails. The wheels can be adapted to 4 ft. 8½ in., 5 ft., 5 ft. 6 in., or 7 ft. or a wider gauge of rails.

The lifting and radiating can be performed at the same time, and the Crane radiated either to right or left without reversing the engines.

ENGINES.—There are two cylinders, each being 6½ in. internal diameter, and 11 in. stroke, with metallic piston rings, brass tongues and steel springs, cast-iron junk ring, steel piston and valve-rods, the rods attached to valves by wrought-iron bridle, all joints faced metal to metal, bright covers to cylinders fitted with grease and water cocks; the guide to piston is formed by an extension of the piston-rod working in a patent metal bush, piston-rod fitted with solid wrought iron crosshead, solid forked connecting rods got up bright throughout, and fitted with gun-metal bearings, and with straps, cotters, and jibs to take up the wear. The crank shaft is 2½ in. diameter, of scrap iron forged solid, and the jaws of crank slotted out and got up bright, the bearings in gun-metal of extra length. The Engines are fitted with Cornes and Bruckshaw's patent reversing motion, and have only one eccentric and rod to each Engine, the eccentric being shifted on the shaft while running, and entirely doing away with the wear and complication of the links; or link motions of the usual description will be supplied if desired. The glands to piston and slides are of gun-metal.

BOILER.—The Boiler is vertical, 3 ft. 2 in. diameter by 7 ft. high; fire-box 2 ft. 6 in. by 3 ft. 8 in. high, with two cross tubes 6 in. diameter at right angles to each other; the shell plates are of best Staffordshire iron ⅜ in. thick, and the fire-box and cross and flue-tube of Lowmoor plates ⅜ in. thick, the flue-tube being 8 in. diameter.

The working pressure is 45 lbs., and the Boiler is tested by hydraulic pressure to 120 lbs., and is fitted with furnace-bars, bearing ring, man-hole doors and bridges, four mud-holes around the bottom of water-space fitted with doors and bridges. The steam fittings consist of a patent steam gauge, safety valve, and Salter's patent spring balance, patent water-gauge, two gauge cocks, gland blow-off cock, safety plug in fire-box, cast iron chimney and dampers.

DONKEY PUMP.—The Boiler is fed by a direct-acting donkey pump, the steam cylinder is 3 in. diameter by 3 in. stroke, and the plunger 1½ in. diameter working in a gland bushed with gun metal, metallic ring in piston, valve boxes of gun metal fitted with spherical valves; grease cock in cylinder, and pet cock in pump. It is fitted on the side of Boiler with suction and delivery pipes, and ¾ in. gun metal suction cock and check valve.

* To calculate the working load of a properly proportioned Crane at different radii, multiply the ascertained safe working load at any given radius by the radius in feet, and divide the product by the radius required, the result will be the safe working load at that radius. For instance, a Crane which will carry 30 cwt. at 30 feet radius will be equally safe with 45 cwt. at 20 feet radius, thus

$$30 \times 30 = \frac{900}{20} = 45 \text{ cwt., the safe working load at 20 ft. radius.}$$

TANK.—The feed-water Tank is of ample size, having a capacity equal to 130 gallons, the top being composed of chequered plates, and forms part of the foot plate for driving and stoking from.

LIFTING GEAR.—The Lifting Gear is single purchase, and of ample proportions. The pinion is made to draw quite out of gear when lowering by break, which prevents the noise and risk of breaking the teeth from back lash; the pinion is fitted with forked lever for this purpose.

BRAKE.—The Brake wheel is keyed on the end of the hand shaft opposite to spur wheel, and is fitted with wood lined strap, compound lever worked by the foot, the foot lever being fitted with a pawl to keep the load suspended if required. The Brake is equal to hold the greatest load lifted with ease and safety.

RADIATING AND TRAVELLING GEAR.—The radiating motion is transmitted from the engine shaft by double friction clutches, which can be thrown into gear whilst raising a load, and radiate in either direction, the clutches being fitted with an eccentric lever for moving them; the same clutches also give motion to the patent travelling gear for moving the crane on the rails, which cannot well be explained without a drawing, but the travelling motion can be transmitted to the travelling wheels at whatever angle the Crane may be across its carriage.

DERRICK GEAR.—The jib of the Crane has a Derrick motion, giving a variable radius from twelve feet and above, and can be worked when the load is on if required; the first motion is given by a bevil wheel on the crank shaft, made fast or loose by a tooth clutch to an upright shaft with a worm, forged solid on its upper end and case-hardened, gearing into a worm wheel keyed on to the Derrick barrel shaft, double chains are led from this barrel round the snatch block to the jib head.

HAND SHAFT.—The Crane is fitted with Hand-motion Shaft for working the Crane if steam is down, or in case of accident to engine or boiler.

SIDE FRAMES.—The Side Frames are of cast iron with all the necessary carriages and brackets for carrying the shafts and gear, and all the high speed shafts are fitted with gun metal bearings, loose cap, and lock nuts.

CRANE POST.—The Crane Post is of hammered iron of ample section, and it is turned and keyed into the carriage, and turned, where required for the frame work of Crane to revolve.

JIB.*—The Jib is composed of best pine or memel timber, splayed out from the top towards the bottom, and trussed between to give the necessary stiffness; the lower end is fitted into cast iron sockets with eyes bored, and working on a turned carriage to form the fulcrum of Jib, the carriage is fitted with turned sheave to take the thrust of the Jib, and one is also fitted at the back of framing to take the back weight of the boiler and tank when the load is off.

CARRIAGE.—The Carriage is in one massive casting, with cone ring on top truly turned, the carriage being chequered on surface.

WHEELS AND AXLES.—The four travelling wheels are 2 ft. 8 in. diameter, turned on the faces, and keyed on wrought iron axles 3½ in. diameter, turned in the journals.

HOLDING DOWN CLIPS.—The four horns of the carriage are fitted with Holding Down Clips for double head rails and tightening screws.

CHAINS.—The lifting Chain is ¾ in. diameter, best tested short link, fitted with swivel hook and balance ball for overhauling the chain, and it is of sufficient length to reach 30 feet below ground line. The derrick Chains are ⅝ in. diameter, fitted to barrel and jib, and of proper length to give the radius specified.

THE ROOF.—The Roof is of sheet iron (for convenience of packing and shipment), bolted together in segments, and to the wrought angle iron rings on the under side; it is supported by two wrought iron posts bolted to the tank on each side of the boiler, and by a strong bar of flat iron secured to the Crane and to the angle iron rings. This roof is a great protection to the machinery and to the driver in a hot sun or in bad weather. If desired the whole of the machinery can be inclosed by boards resembling shutters, which can be wholly or partially taken down when the Crane is at work.

* If a wrought iron jib is preferred to timber, it would be furnished without additional charge.

FIFTEEN TON LOCOMOTIVE STEAM CRANE.

Portable Steam Cranes to work loads of from 15 to 20 tons have hitherto rarely been constructed; this is owing, to some extent, to their rather heavy cost, but it is perhaps mainly due to the width of gauge necessary to give a sufficient wheel base, which is too great to allow these Cranes to run on the same gauge as the ordinary rolling stock; but there can be no doubt that one such Crane would do the work far more expeditiously and economically than several Hand Cranes *fixed* along a quay or wharf; and when the question of cost is fairly considered, the balance will certainly be in favour of the Steam Crane, because the cost of 3 well constructed Hand Cranes, with the necessary foundations, will be at least equal to that of the Steam Crane, which will easily do the work of 6 Hand Cranes, whilst, as will be seen from the subjoined description of such a Crane which has been designed by the authors, provision is made for working light loads at high speed, and for giving a variable radius, so that, although the Crane is of the most powerful description, practically it is as handy in working as the lighter Cranes described in the following pages.

The Crane under consideration has 2 outside cylinders each 8 inches diameter, with link motions, and the crank shaft is fitted with 3 pairs of mitre wheels, each pair gearing into a third mitre wheel and having large double friction clutches worked by eccentric disengaging levers.

The first set of mitre wheels gives the radiating motion in either direction without reversing the Engines; the second set gives the travelling motion in the same manner; and the third set alters the radius by raising or lowering the jib.

A wheel with spur gear on its periphery and bevil gear on its lower side runs loose on the crane post. Motion is imparted by the first set of mitre wheels to this spur wheel, and through it to three pinions working into the bevil gear above named. Each pinion is keyed on a shaft with a conical friction roller on the other end, making them *all driving wheels*, and these three rollers are arranged so as to take the whole weight of the superstructure, whether the Crane is turning round empty or with its full load. The second set transmit the travelling motion. The crane-post is of wrought iron, bored and fitted with a central shaft, with gear on the lower end working into a pair of mitre wheels on the central travelling axle; this axle carries two chain wheels, from which motion is transmitted to the leading and trailing wheels, thus making *each of the six travelling wheels, drivers.*

The third pair gives the motion for raising or lowering the jib, chains passing over blocks and coiled round a fuzee barrel, worked by a worm and wheel taking the place of the ordinary rigid tie bars.

The lifting gear can be worked by *hand* or steam power in single, double, or treble purchase, and when the heaviest lifts are made the chain is reefed to the jib head.

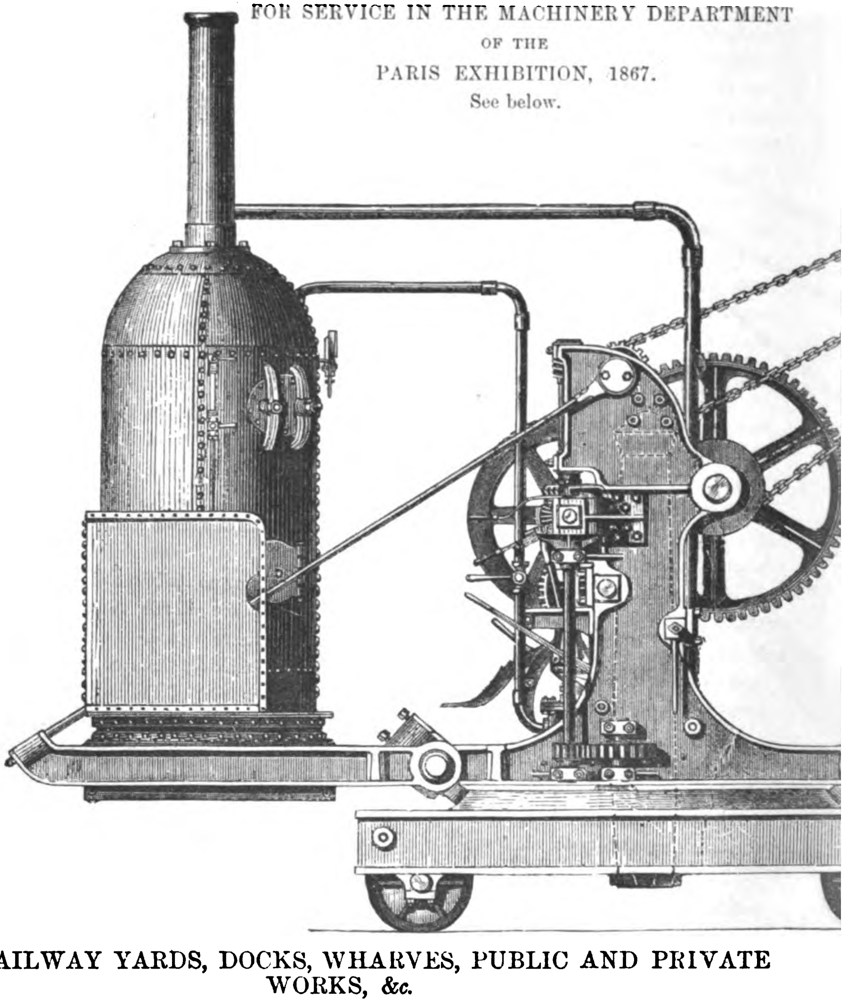
If the Crane has to run on a rather narrow gauge the base is fitted with transverse girders having screws at the ends which are set down on the quay when the full load is lifted, thus giving a square base.

The radius is a maximum of 30 feet and a minimum of 15 feet, but these proportions can be varied to suit any special circumstances.

The price of this Crane, complete with boiler, feed-water tank, feed pump, chains, &c. is £800, and the weight about 30 tons. It can, however, be shipped in parts not exceeding 4 tons for the heaviest piece.

No. 333. LOCOMOTIVE STEAM CRANE.

SELECTED BY H. B. M. COMMISSIONERS
FOR SERVICE IN THE MACHINERY DEPARTMENT
OF THE
PARIS EXHIBITION, 1867.
See below.



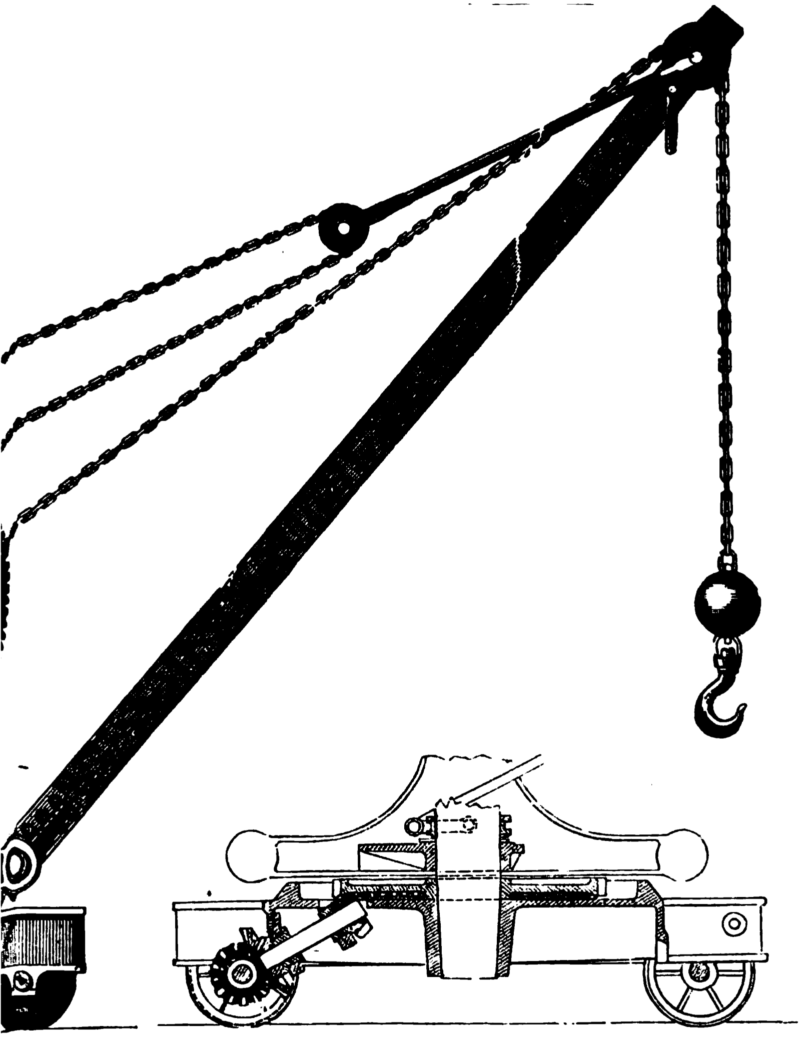
FOR RAILWAY YARDS, DOCKS, WHARVES, PUBLIC AND PRIVATE WORKS, &c.

THESE Cranes have been specially designed for use in situations where the work is of a varied character, and where great speed and economy in working are required.

They are made to lift and turn entirely round in *either* direction without stopping or reversing the engines, and the lifting and turning motions can both be in work at one time. The boiler and feed-water tank revolve with the Crane, and form a useful counterbalance to the load. If fitted with APPLEBY'S PATENT STEAM TRAVELLING and STEAM DERRICK MOTIONS, the Driver will travel the Crane along the road, and alter the radius of the Jib, either operation being performed with or without the load suspended.

All the motions are worked by one man, and the economical working results obtained from these improvements will be apparent when it is considered, that without them a gang of men is required to bring the loads to the Crane, whilst with them the work is done with far greater speed and economy by one man.

These Cranes are fitted to work in all motions by hand when steam is down



Prices will be quoted on receipt of information as to the gauge of rails, the weight to be lifted, and the maximum radius required.

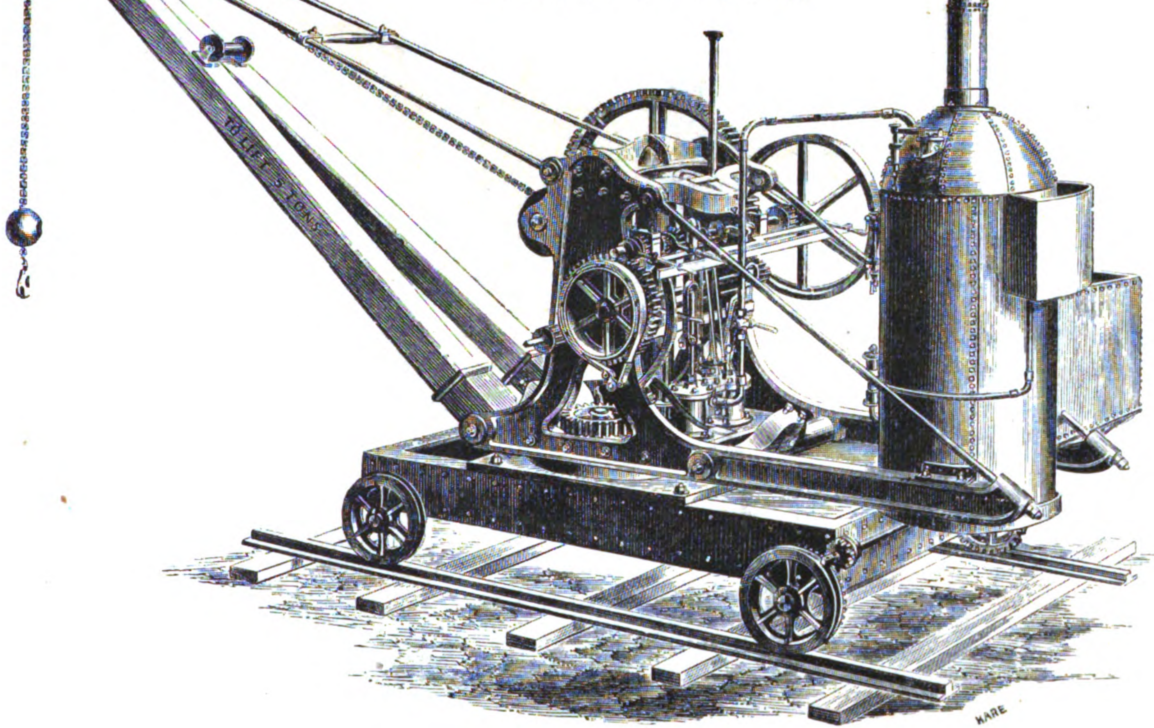
Although the bottom of the tank is a sufficient height from the ground to clear any ordinary package, there are some situations where in turning round it is desirable that the boiler should describe the smallest radius possible, and in such cases the space available for that purpose should be stated. (*See* p. 11.)

The use of this engraving has been kindly permitted by the Editor of "THE ENGINEER," who selected APPLEBY BROTHERS' Crane for illustration, and described it as one of the best specimens of that class of machinery in the Paris Exhibition, 1867, where it was used for unloading the machinery exhibited in the English section and for placing the heavier pieces in position, as well as for removing them after the close of the Exhibition, the STEAM TRAVELLING and STEAM DERRICK motions being of great value in this service.

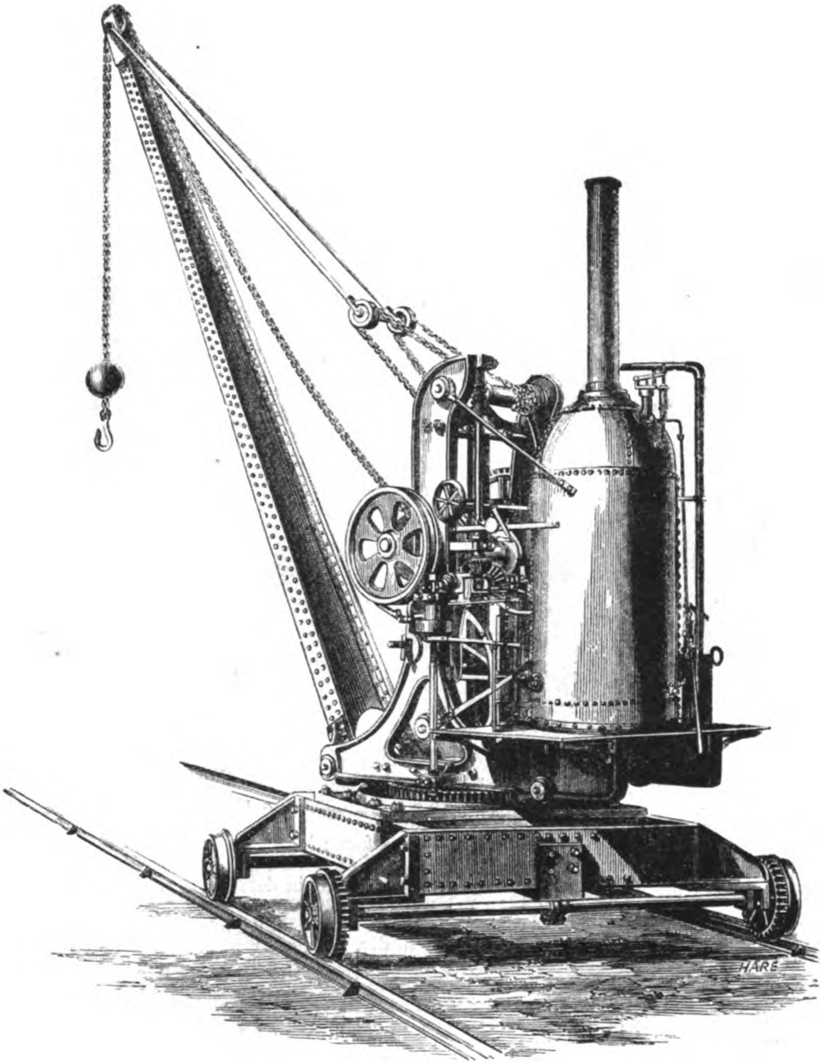
That this section was in a more forward state at the opening, and was cleared more rapidly than any other after the close of the Exhibition, is perhaps chiefly due to the extensive and judicious employment of steam power as a substitute for manual labour for the purposes indicated.

To lift and turn entirely round in either direction by Steam or by Hand.

Five Ton	£350
Three Ton	250
Two Ton.	200



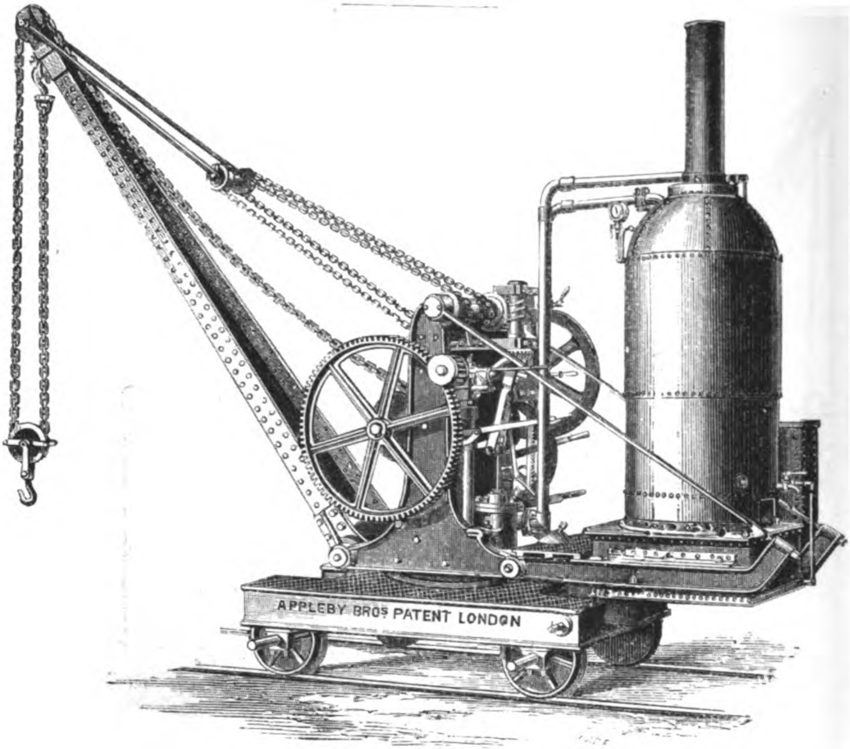
(No. 3.) FIVE TON PORTABLE STEAM CRANE.



(No. 33.) PORTABLE STEAM DERRICK CRANE.

THE Crane illustrated at pp. 8 and 9 is made for any gauge of railway, but there are many situations where in turning round it should describe the smallest radius possible (see p. 9), and to give the necessary stability to the machine when lifting at a long radius, the wheel base is increased in the manner shown in the above engraving, an extra rail being laid for the outer wheel to run upon; by this means the Cranes may be worked in a very contracted space with perfect safety.

These Cranes are usually made to lift loads of three tons at the long radius, and about five tons at the shorter radius, but they are modified to do almost any variety of work which can be required. No. 3 Crane without Derrick motion, to lift 3 tons at 20 feet radius, and turn by steam, price £320. For working expenses and results, see pp. 12, 13.



No. 24 STEAM CRANE, WITH STEAM DERRICK MOTION.

This Crane was originally designed for lifting earth and the materials used in the construction of the Thames Embankment, and since then a large number of them have been employed on most of the public works in London and elsewhere.

For these purposes the steam derrick motion is found highly convenient, as the radius can be immediately increased or diminished, to adapt it to the work in hand.

The construction is generally similar to that described in detail at p. 5, but there is only one steam cylinder. Those who have not used steam Cranes with one cylinder, frequently object to them as being inconvenient, on account of their liability to stop on the dead centre, but with a properly balanced fly-wheel, practically, no inconvenience is experienced. The reasons which induced the authors to adopt this arrangement were, that Cranes being liable to more rough usage than almost any other tool, the working parts cannot be too strong, and there is evidently far less wear and tear in the working parts of one large engine than in two small ones. The correctness of this view has been amply proved by the small amount of repairs required in continuous and hard work, extending over a long period; they are therefore led to the conclusion that the single cylinder is advantageous in all Cranes which have to lift loads of up to 30 cwt. in single purchase, with occasional lifts of up to 50 or 60 cwt. in double purchase.

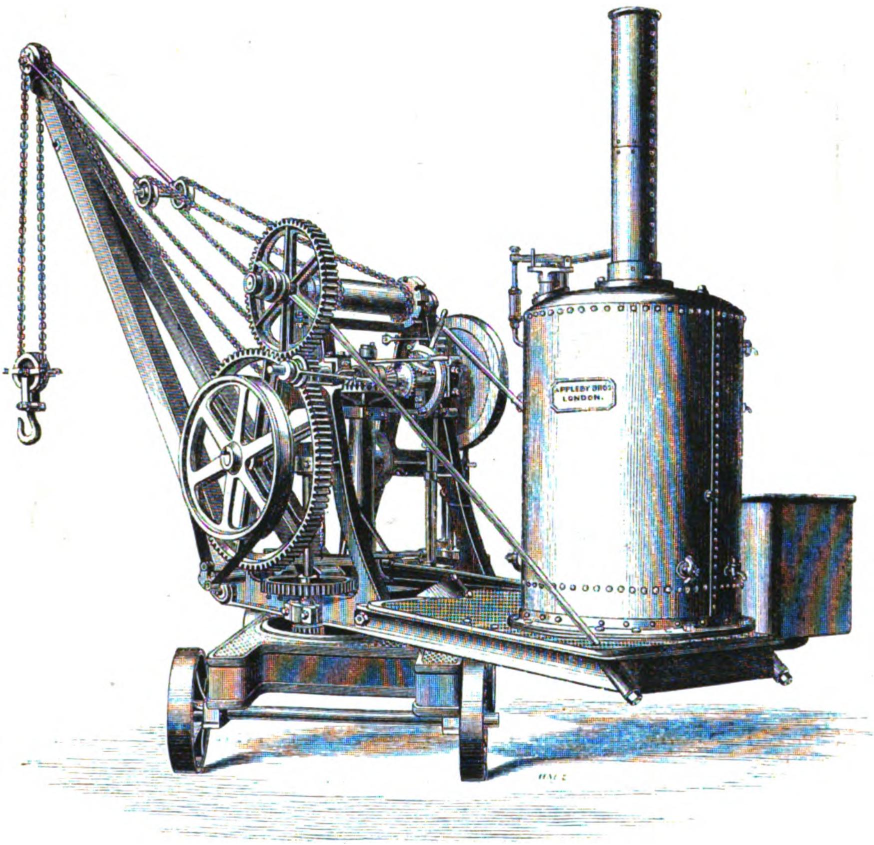
The No 24 Crane will lift loads of 30 cwt. at a speed of about 60 feet per minute, at a radius of 18 feet; and with a return chain and snatch block, 50 to 60 cwt. at 12 feet radius, or loads of intermediate weight at proportionate radii.

No. 24 Crane, as described, price £260; weight about 7½ tons.

No. 224 Crane lifts, turns, and travels on the rails by steam, and has a fixed jib, price £265; weight about 7½ tons.

No. 324 Crane lifts, turns, travels, and has the Derrick apparatus for altering the radius, all by steam, price £275.

In each Crane all the motions are worked by one man, the working expenses, including driver, fuel, oil, wipings, is about 10*s.* per day, and the average attained during many months' working was 300 tons per day, lifted 30 feet high, and deposited in railway trucks.



No. 25 STEAM CRANE, WITH STEAM DERRICK MOTION.

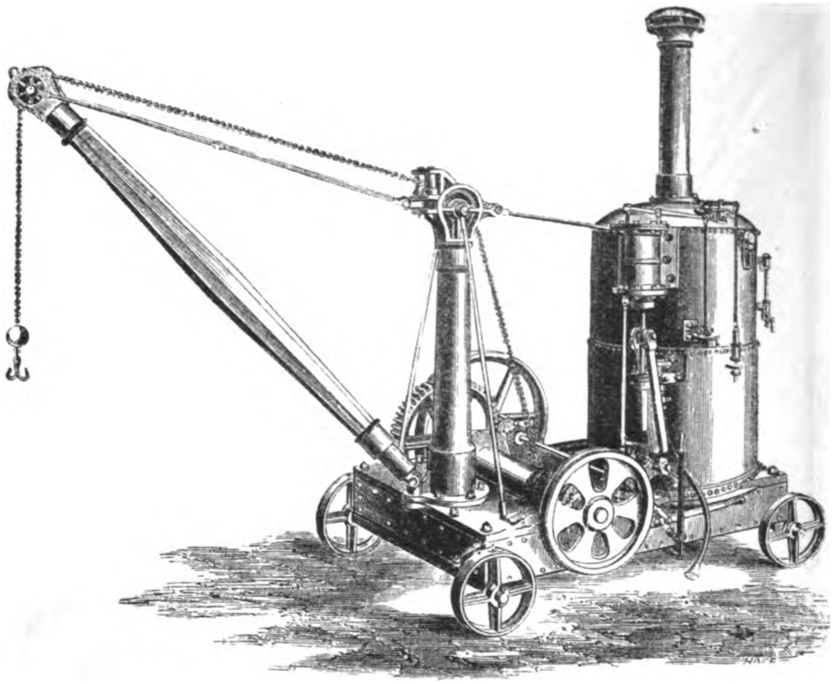
The foregoing description will apply generally to the present engraving, both as regards arrangement and speed of working, the main points of difference being, that the proportions throughout are less massive than in the No. 24 Crane, it being calculated for working loads of 20 cwt. at about 16 feet radius, or up to 30 cwt. at a short radius.

No. 25 Crane, with steam lifting, turning, and Derrick motion, price £190; weight about 5 tons.

No. 225 Crane, lifts, turns, and travels on the rails by steam, and has a fixed Jib, price £200; weight about 5 tons.

No. 325 Crane, lifts, turns, travels, and has a Derrick apparatus for altering the radius, all by steam; price £210; weight about 5 tons.

All the motions are under the control of the driver, and the working expenses are about 9*s*. per day.

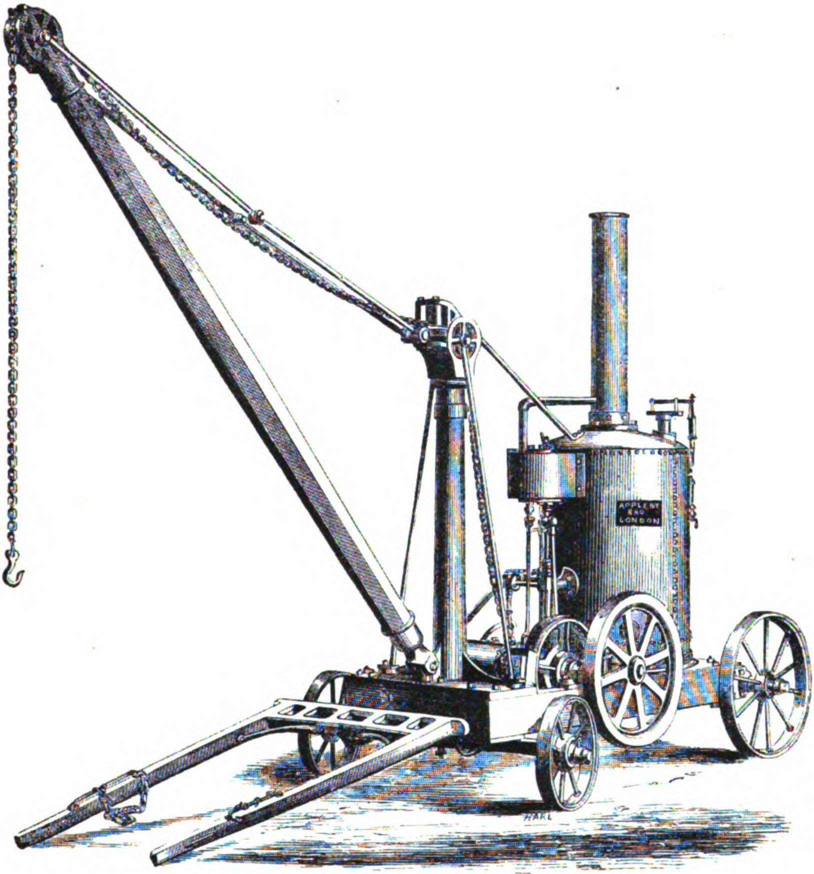


(No. 13.) STEAM CRANE TO SWING ABOUT THREE-QUARTERS ROUND BY HAND.

THESE Engines are mounted upon strong Iron Carriages, with Wrought-iron Axles, and Plain or Flanged Wheels for Rail or Road, and they are usefully and economically employed on Railway, Sewer, and similar Works, or for loading and discharging cargo. They can be fitted with Capstan Ends, with Chain Pullies, or a Rocking-shaft for working Pumps, or by removing the Jib they can be used as a Steam Pile-driver, for driving Mortar-mills, Sawing-machinery, or for any purpose to which an ordinary Portable or fixed Engine can be applied, and the cost is less than that of ordinary Portable-engines of corresponding power.

No. 13.—7-Horse power Steam Crane, with one cylinder, and with single purchase only, to lift 30 cwts.	£215	0	0
If fitted with patent Frictional Gear, so that the Engines may be *constantly running*, and used for driving a Mortar-pan or other Machinery *at the same time as it is used for lifting* . .	235	0	0
If fitted with Link-motion, extra	7	10	0
No. 14.—4-Horse power Steam Crane, similar to No. 13, but to lift 1 ton	170	0	0
If fitted with patent Frictional Gear	187	0	0
If fitted with Link-motion, extra	7	0	0
If with Capstan on end of Barrel shaft, extra	3	0	0

For varied application of this crane, see pp. 16, 17.



(No 15.) STEAM CRANE TO SWING THREE QUARTERS ROUND BY HAND

THE main points of difference between this Crane and that illustrated and described at page 14 are, that this is fitted with wrought-iron travelling wheels, the front pair with locking plate, and supplied with shafts for being readily moved from place to place on ordinary roads; when travelling the jib is usually taken down and laid in a crutch on the wrought-iron frame.

These Cranes are chiefly required for lifting light weights, say up to 5 or 6 cwt. at a high speed, and with the patent frictional gear, they are worked by a boy or an ordinary labourer and at great speed; but some of them have been made to work as steam pile-drivers, with a monkey weighing about 15 cwt.; for this purpose a double purchase is required, the first motion being given by frictional gear wheels, and the second purchase by the ordinary spur gear. When used for pile-driving the upright post and the jib are removed, so as to give a clear run for the chain on the Barrel.

In some cases the Engine has been used for driving a small Mortar Pan, No. 3 described at page , with highly satisfactory working results.

No. 15. Steam Crane with Engine of 3-horse power, patent frictional gear, and complete, as shown, price £130.

With double purchase as described above, about £10 extra.

If without the jib and post, for use as a Hoisting Engine, £118.

With link motion, extra £7.

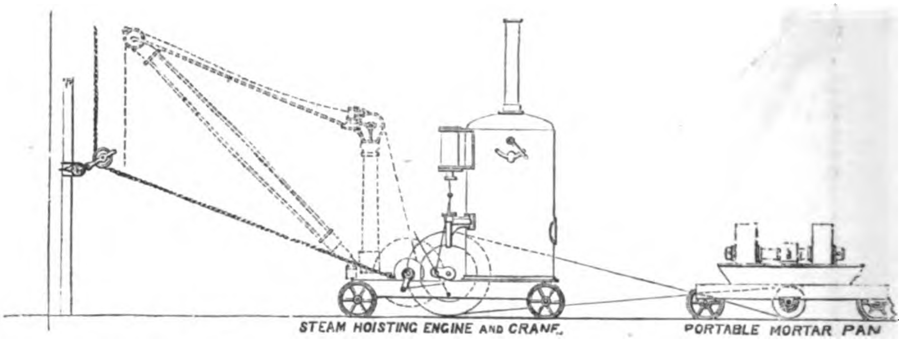


FIG. 1.—Elevation of No. 13 HOISTING ENGINE (or STEAM CRANE) with Patent Frictional Gearing, and Mortar Mill attached.

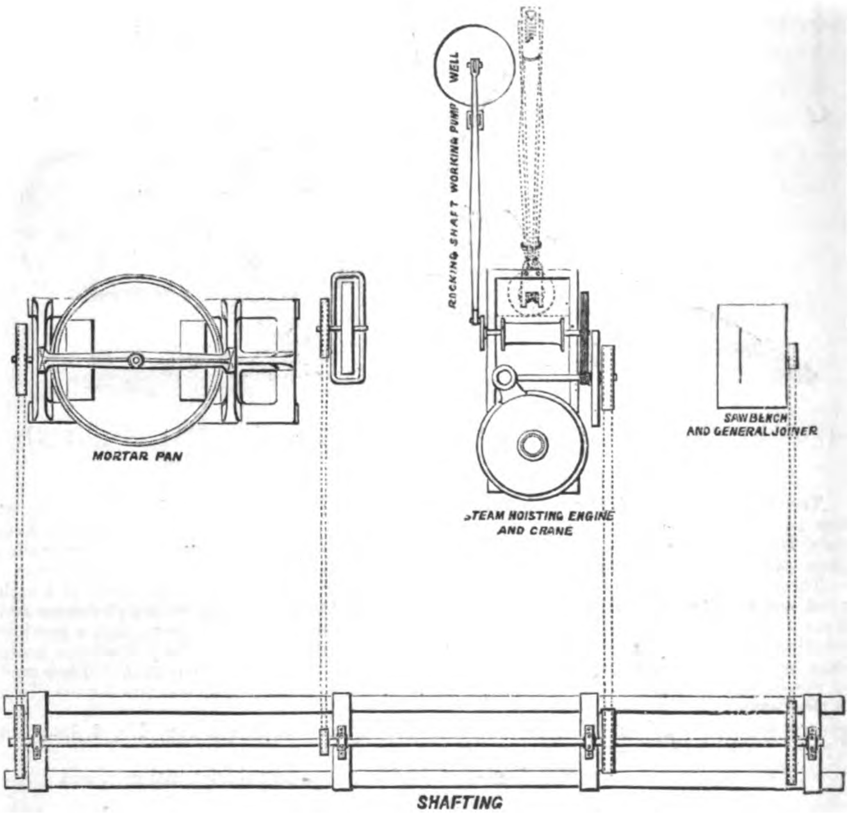


FIG. 2.—SKETCH PLAN, showing the same Engine set out for working the machinery usually required in the construction of large buildings.

STEAM CRANES AND HOISTING ENGINES. Nos. 13 and 13A.

These Engines can, without alteration, be used—

As Portable Steam Cranes,

As Portable Steam Engines for driving Mortar Pans, Wood-working Machines, Pumps, Brick Machines, &c.

As Steam Hoists, Winding, or Hauling Engines,

As Pumping Engines with Centrifugal Pump or a Rocking Shaft,

As Overhead Steam Cranes with Cross Travelling Motion,

As Steam Pile Drivers, to work with an ordinary Hand Engine Frame,

As Engine and Crab for Dredging, with Bag and Spoon.

The first cost is about the same as that of the ordinary Portable Steam Engine of equivalent power; the Boilers are constructed with large Fire Boxes to burn coal, coke, wood, or builders' refuse materials, and they are less liable to get out of order than Multitubular Boilers.

Being applicable to such a great variety of purposes, there are few contracts where one could not be profitably employed, as, in addition to the great saving in manual labour for lifting, the Engine can, if fitted with Patent Frictional Gear, at *the same time* be used for that purpose *and also* for grinding Mortar, Sawing, Pumping, &c.

The cost of working one of these Engines (No. 13) in London is as follows:—

	£	s.	d.
7 Sacks of Coke @ 1s. 2d.—about 8 cwt. coal.* . .	0	8	2
Engine Driver*	0	5	0
Boy*	0	2	6
Oil, Waste, &c	0	1	9
	£0	17	5

* The cost of these items will vary in different localities.

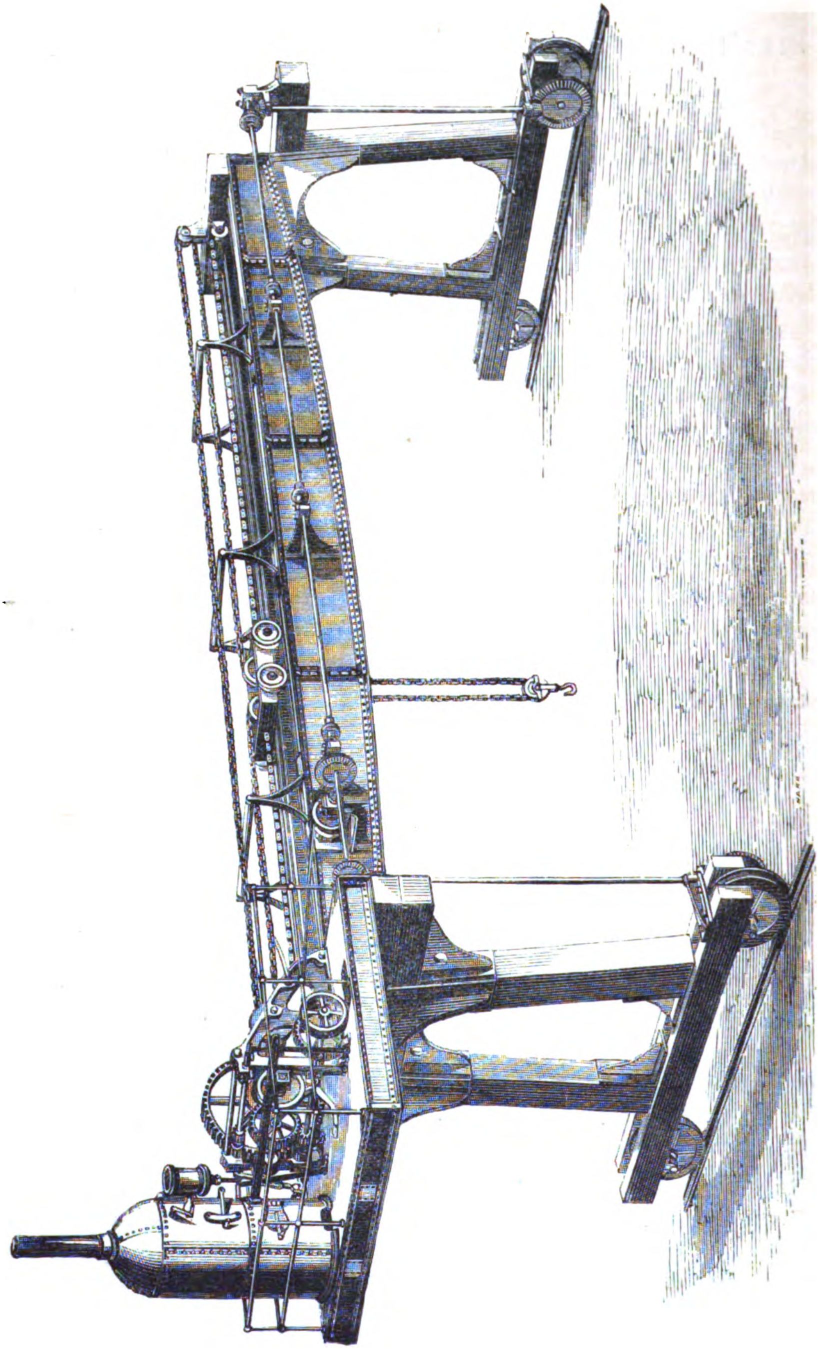
Total work in the day of 10 hours,—Engine lifting about 165 tons 30 ft. high, and at the same time grinding mortar for a gang of bricklayers.

The consumption of fuel when the engine is *lifting only* is 3¼ sacks of coke per day, the other working expenses being about the same as when the mortar pan is driven, therefore lifting 165 tons 30 feet high, costs 13*s.* 4*d.* = barely 1*d.* per ton, and the extra cost of power for grinding the mortar is 4*s.* 1*d.*

Fig. 1 is a sketch elevation of the engine with Patent Frictional Gear, working mortar pan, and lifting materials at the same time, either as a Crane or Steam Hoist.

Fig. 2 is a sketch plan of the Engine set out for working the machinery usually required in the construction of large buildings.

These engines and tools are usually kept in stock ready for immediate delivery



(No. 14). STEAM "GOLIATH," OR WELLINGTON TRAVELLER.

(No. 1A.) STEAM "GOLIATH," OR WELLINGTON TRAVELLER.

The Engine, Boiler, and double-purchase Gear are fixed at one end of the frame, the same as No. 1 Steam Traveller, but the No. 1A has only one Winding Barrel.

From this Barrel the chain runs over a sheave or chain pulley at the opposite end of the frame or gantry, and thence to the jenny block, which is moved backward and forward by a pitch chain as shown, and the longitudinal travelling motion of the whole is given by the pinions on the vertical shafts, gearing into wheels keyed on to the axles of the travelling wheels.

The advantage this Traveller possesses over most others is that the great cost of Staging can frequently be avoided, and that the longitudinal as well as the transverse motions are worked by steam. Even when a permanent staging is necessary, the Engine and Gear can be transferred to an Overhead Traveller of the ordinary construction, and it is available for immediate use without alteration.

The Crab is made to work by hand if required, and the Engine can be detached and used as a portable or fixed Engine for driving Saw Benches, Pumps, or other machinery.

For shipment abroad and for use in distant parts of the country, timber girders, trussed as shown in p. 21 and p. 59, are found to answer the purpose at a lower first cost than the wrought-iron girders shown in the accompanying engraving. In such cases the whole of the iron work for any given span and weight is supplied properly marked for erection, together with the Engines, Boiler, and Gear, and working drawings are furnished for the timber work, and for the erection of the whole.

Many modifications of the arrangement of machinery have been made with good working results. In some cases where the ground is uneven, one leg of the Traveller is made longer than the other, in others, the Engine, Boiler, and Gear have been brought down to the rail level with an extra pair of wheels, and a line of rail for them to run on.

In some instances where the last-named plan is adopted, the Traveller is made of sufficient span to command the stone-dressing sheds and the work in progress; these sheds are provided with moveable roofs made in lengths, and when a stone is ready for removal the Traveller takes off the portion of the roof over the stone. It then picks up and deposits the stone where required, puts down another in the shed ready for the mason's hand, and replaces the roof.

One such Traveller will serve a large number of masons, and effect a very great economy in time and in working expenses, and the speed of travelling both longitudinally and transversely being greater than that usually employed, they are not only found cheaper and quicker in work than horses, but the cost of tramways and the space occupied by them is also saved.

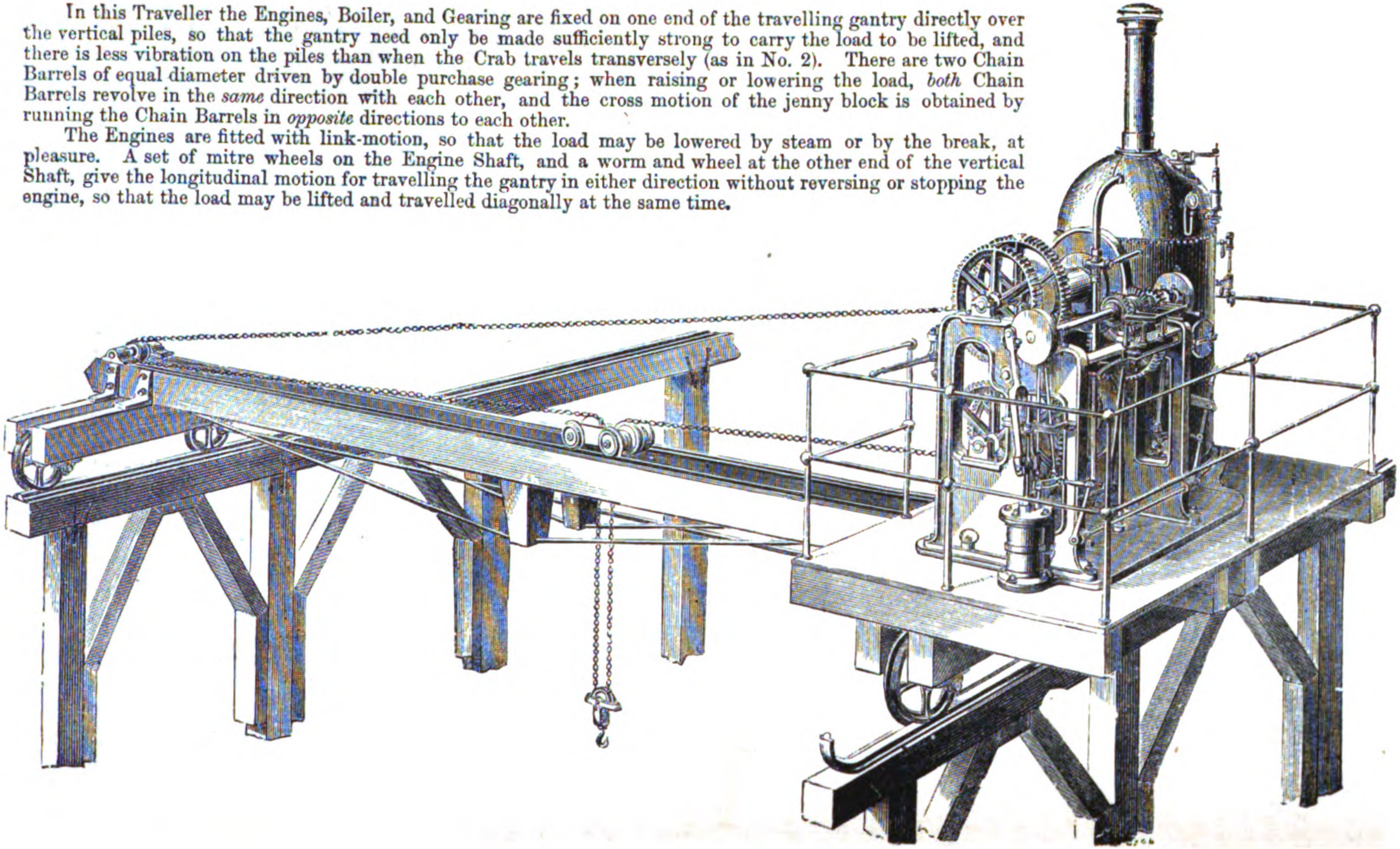
This arrangement is therefore found invaluable in Quarries and other works where the ground is frequently changed, and it has been applied to Wellington Travellers originally made to work by hand.

All applications for prices must be accompanied by information as to the maximum load to be lifted and the span required. If any special arrangement is necessary a sketch of the ground should be furnished, together with ample details of the work to be done.

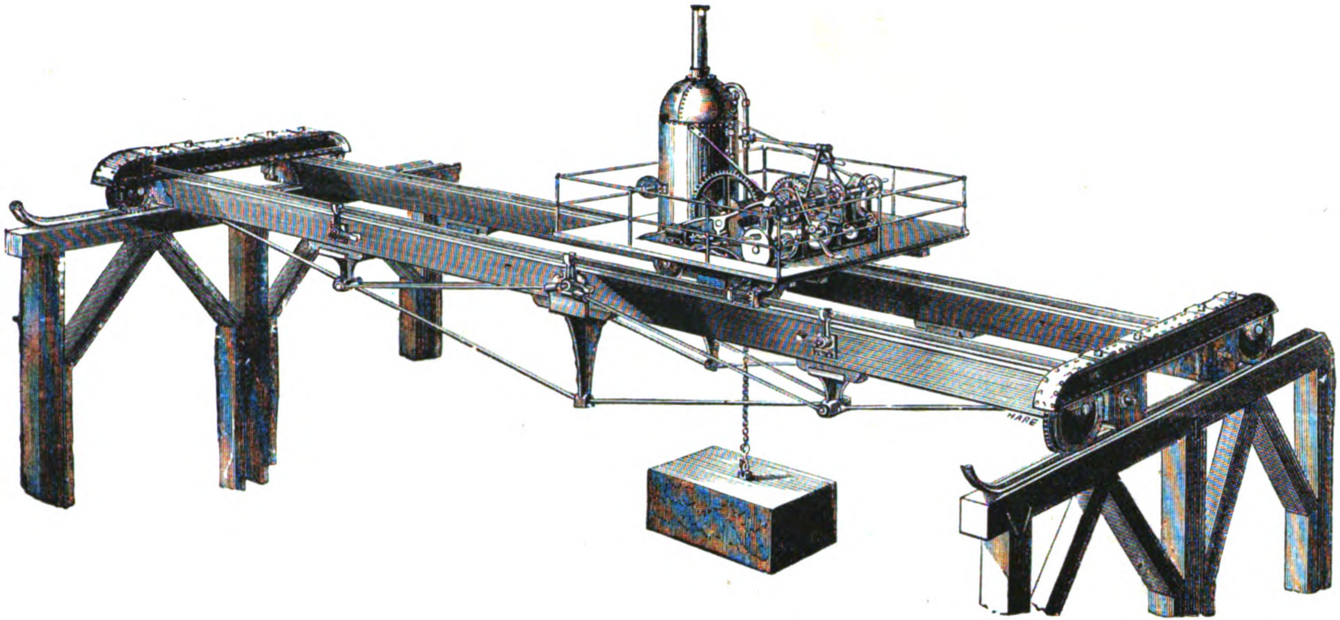
STEAM OVERHEAD TRAVELLER, see pp. 20 and 21.

In this Traveller the Engines, Boiler, and Gearing are fixed on one end of the travelling gantry directly over the vertical piles, so that the gantry need only be made sufficiently strong to carry the load to be lifted, and there is less vibration on the piles than when the Crab travels transversely (as in No. 2). There are two Chain Barrels of equal diameter driven by double purchase gearing; when raising or lowering the load, *both* Chain Barrels revolve in the *same* direction with each other, and the cross motion of the jenny block is obtained by running the Chain Barrels in *opposite* directions to each other.

The Engines are fitted with link-motion, so that the load may be lowered by steam or by the break, at pleasure. A set of mitre wheels on the Engine Shaft, and a worm and wheel at the other end of the vertical Shaft, give the longitudinal motion for travelling the gantry in either direction without reversing or stopping the engine, so that the load may be lifted and travelled diagonally at the same time.



(No. 1.) OVERHEAD TRAVELLING STEAM CRANE.



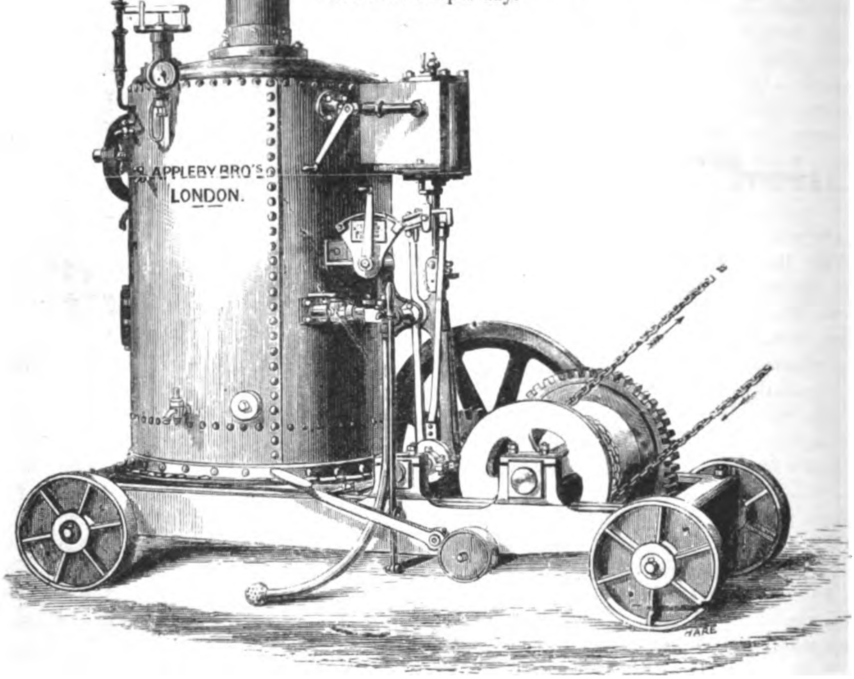
(No. 2.) OVERHEAD STEAM TRAVELLING CRANE.

This Engine, instead of being stationary at one end of the gantry (like No. 1 Steam Traveller), is made to travel upon it with the load; all the motions are direct, and the snatch block and jenny block are dispensed with (which some authorities prefer); the engines are fitted with single and double purchase gearing, case-hardened link motion for reversing, strap break with foot lever and pawl to hold the load suspended when required; the longitudinal and transverse travelling motions are driven by sets of friction clutches, so that without stopping or reversing the engines the load may be lifted and traversed longitudinally and transversely all at the same time, and the levers are all under the immediate control of one man.

(No. 13 A.) STEAM BARROW LIFT, OR HOISTING ENGINE.

The Boiler, Engine, and Gear are mounted on a strong iron frame, fitted with plain or flanged travelling wheels, which are so arranged that the machine can be travelled in the direction shown, or in the opposite direction if desired. The Boiler has an ash-pit, so that it may stand on a timber staging or floor without danger.

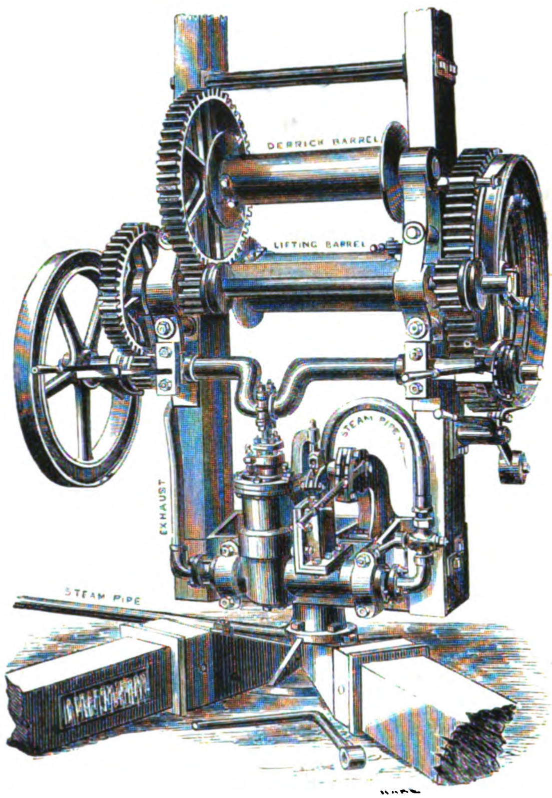
For Barrow-lifting the chain leads off opposite sides of the Barrel, and in many cases it is carried by a leading block at an angle, or in any direction required. In addition to being cheaper to work than horse runs, much time is saved by an empty Barrow being lowered at the same time that the full one is being hoisted. These Machines are so simple that they are usually worked by boys, and in London, where labour is expensive, the cost of working, including wages, 2*s.* 6*d.* per day, fuel, oil, &c. does not exceed 4*s.* 6*d.* per day.



Price, with Link Motions, Break, &c. as shown, £125. For Builders' general use they are fitted **with a quick speed for light lifts, and a slow speed for heavy lifts, and with a capstan on the barrel shaft for drawing up materials, at an extra cost of £7 10*s*. And if felted and lagged an additional cost of £7. The winding apparatus can be thrown out of gear, and the Engine then used for driving Machinery, &c.**

These Hoists have been extensively used by Her Majesty's Government on most public works recently carried out, as well as in Warehouses, Factories, &c.

STEAM DERRICK CRANES.



The upright timbers, jib, back stays, sleepers, and the arrangement of chains are exactly the same as in the Hand Derrick Crane, illustrated and described at p. 52, and the Authors have converted many Hand Derricks very successfully to work by Steam; it is, however, desirable that Steam Derricks should have much larger proportions throughout than is usually thought necessary in Derricks to work by hand.

The economy in the use of steam has been found so great, that where Hand Derricks have been converted to work by steam, the whole cost of the alteration has been repaid in one summer's work, and the economy will evidently be still more apparent when a new Derrick is put down, adapted and proportioned throughout to the work to be done.

The Boiler may be fixed in any convenient position; and in some instances one boiler supplies steam to several Cranes, the steam-supply pipe being lengthened or shortened when the Derrick is moved, whilst in others there is a separate Boiler to each.

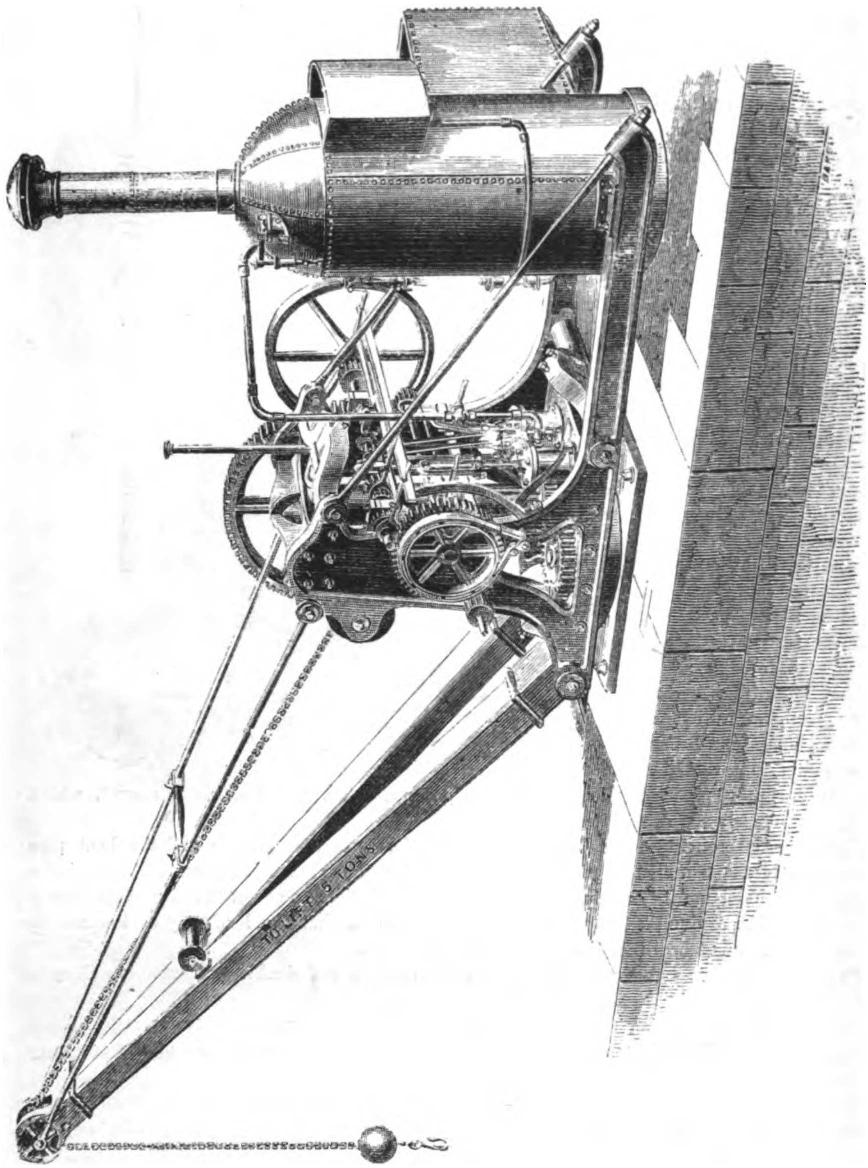
The Steam is brought to the Cylinders through the central bottom pin, and the bent pipe conveys it to the trunnion of the vibrating Cylinder, the exhaust being carried through the opposite trunnion, and it is conducted to any convenient height so as not to obstruct the view of the driver. The engine is fitted with reversing motions, so that the load may be lowered by steam, and there is a break for lowering quickly if desired.

The gear is fitted to work by *Hand or by Steam* in single and double purchase, as well as to work the Derrick Chain Barrel.

As the weight to be lifted, the speed of lifting, and the radius, vary continually, it is difficult and almost impossible to give a scale of prices for these Tools, but some idea of the cost may be formed from the subjoined.

A Steam Derrick to lift up to 2 tons at a speed of 22 feet per minute, and work at any radius up to 40 feet, complete with Boiler, Feed Pump, and all mountings, as specified at p. 31 is worth about £250.

With coal at 21*s.* per ton, and driver at 5*s.* per day, the working expenses will be about 10*s.* per day, and one Steam Derrick will do the work of six Hand Derricks. (See article "On the use of Steam Cranes," p. 2.)



(No. 9.) STEAM WHARF CRANE.

(No. 9.) STEAM WHARF CRANES.

THIS Crane has two Cylinders, fitted with reversing motions, single and double purchase-gearing, the radiating motion can be given in either direction, without stopping or reversing the Engine, and the lifting and radiating motions can both be at work at the same time.

The Jib is so arranged that the radius may be increased or decreased by altering the length of the tie rods.

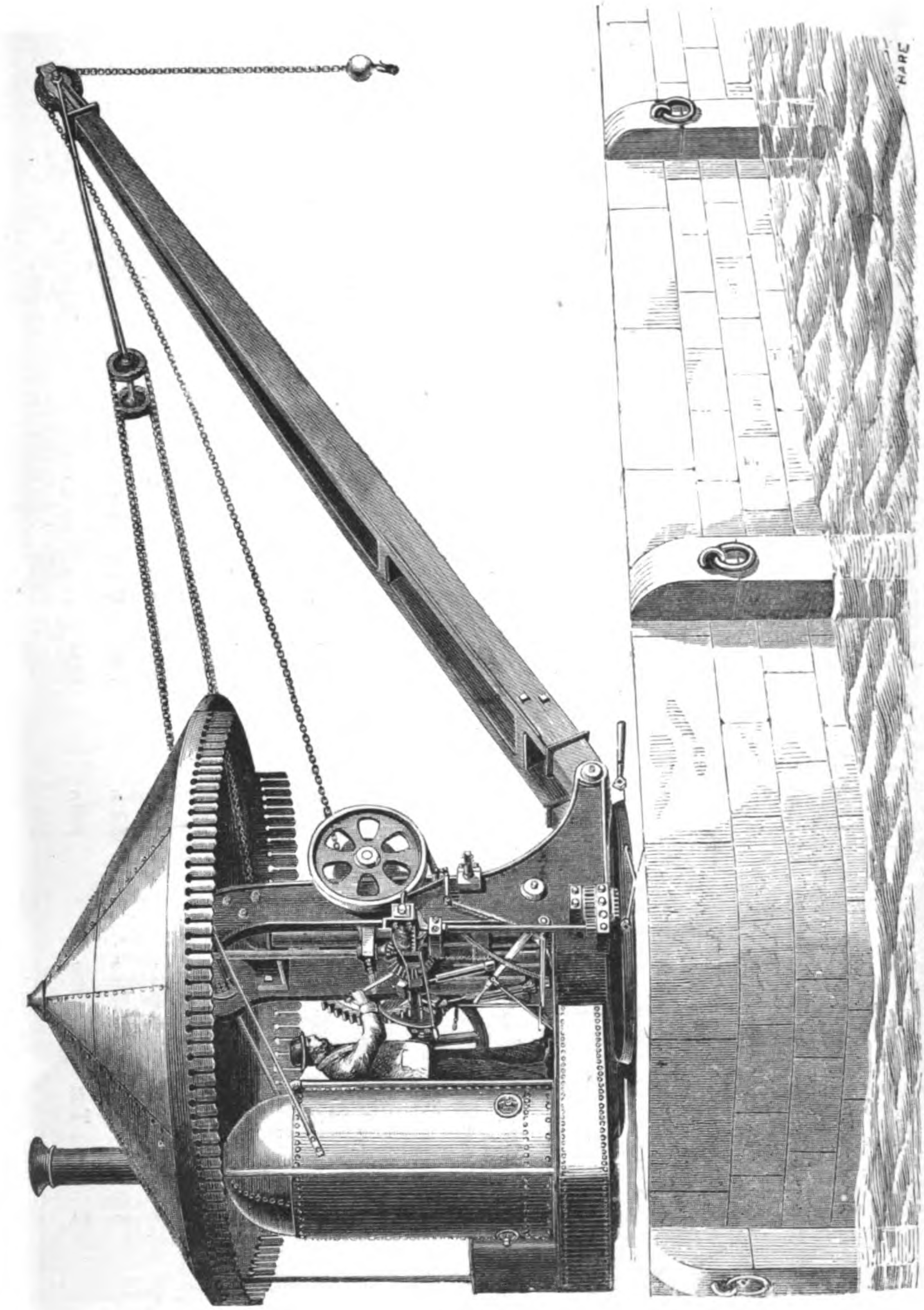
The pull is taken off the cap of the Column by a wheel working on a conical surface on the column.

The boiler is fitted with all necessary mountings, a water Tank, and Appleby's patent feed-pump, which feeds the boiler whilst the engine is standing.

The Crane is made to work from a Stationary Boiler, if required, and for ships' use the Jib is made to take off, and a separate shaft is provided for working the Crane by hand when steam is not up.

The subjoined prices include all the foundation bolts and plates required under ordinary circumstances, also everythin necessary for starting the Engine.

No. 9.—10-Ton Wharf Crane to lift and radiate by steam						£400	0	0
Ditto	5-Ton Wharf Crane		ditto	ditto		300	0	0
Ditto	3-Ton	ditto	ditto	ditto	With one Cylinder	230	0	0
Ditto	2-Ton	ditto	ditto	ditto		180	0	0
No. 29.—(See next page.)—10-ton Wharf Crane to lift, turn, and alter radius by steam 2 Cylinders						460	0	0
Ditto	5-Ton	ditto	ditto	ditto		345	0	0
Ditto	3-Ton	ditto	ditto	ditto	With one Cylinder	265	0	0
Ditto	2-Ton	ditto	ditto	ditto		207	0	0



No. 29. STEAM WHARF CRANE, TO LIFT, RADIATE, AND ALTER RADIUS BY STEAM.

STEAM CRANES AND WINCHES.

Copied by permission from the MECHANICS' MAGAZINE *of November* 23, 1866.

THE exigencies attending the transport of goods is constantly leading to some improvement in the appointed means for facilitating the delivery of heavy articles. The International Exhibition of 1862 did much to bring Steam Cranes before the public, some excellent examples being there shown and used. But since then our manufacturers have made still further advances in perfecting those useful adjuncts of heavy goods traffic. Some of the best steam cranes and winches that have lately come under our notice are those represented in the accompanying engravings,* and which embody all the most recent improvements. We will first describe the construction of the crane, which has two cylinders placed vertically, each 5½ in. internal diameter by 11 in. stroke The crank shaft is forged solid, and the jaws slotted out. The arrangement of guide rods is the same as that in the winches, which we shall presently describe. The crane post is of wrought-iron, and is keyed into a strong cast-iron foundation plate, which, in the case of a ship's crane, is bolted to the deck beams, and the bottom of the post is secured in an iron toe-plate below. The crane post is bored to form a steam passage from below the deck line to the top of the post, which is fitted with a gland and stuffing-box for carrying the steam to the cylinders. The lifting motion is obtained from a pinion with a clutch and lever on the engine-shaft gearing into a wheel on the barrel-shaft. The radiating or turning motion is obtained from a pinion on the other end of the engine-shaft, fitted with clutch and lever, driving a spur-wheel keyed on to a worm-shaft, the worm gearing into a worm-wheel on the crane post.

The brake and other levers for working the various motions are under the immediate command of the driver. Attached to the Crane is Murray's patent drop bottom skip, which is becoming extensively used on board colliers and other vessels for discharging coal. These skips are discharged by the driver from the foot-plate, and effect a considerable saving in time, as well as economizing one man's wages.

To economize space, the boilers are of the vertical form; and instead of a number of vertical tubes, which require frequent repair, these boilers have two or more large tubes across the fire-box, and there is a handhole opposite each tube, so that by removing the cover the tubes may be thoroughly examined and cleaned. The boiler stands upon a wrought-iron tank, which serves as a reservoir for the feed-water, and prevents injury to the deck from the hot ashes, &c. In addition to the ordinary steam fittings, a donkey engine is fitted to the boiler for pumping the water into the tank from the light water line, and from the tank into the boiler as required; but, if necessary, the water may be fed from the light water line direct into the boiler. For long sea voyages, the same boiler can be used for working the apparatus for distilling salt water, for cooking, and for the general supply of hot water and steam.

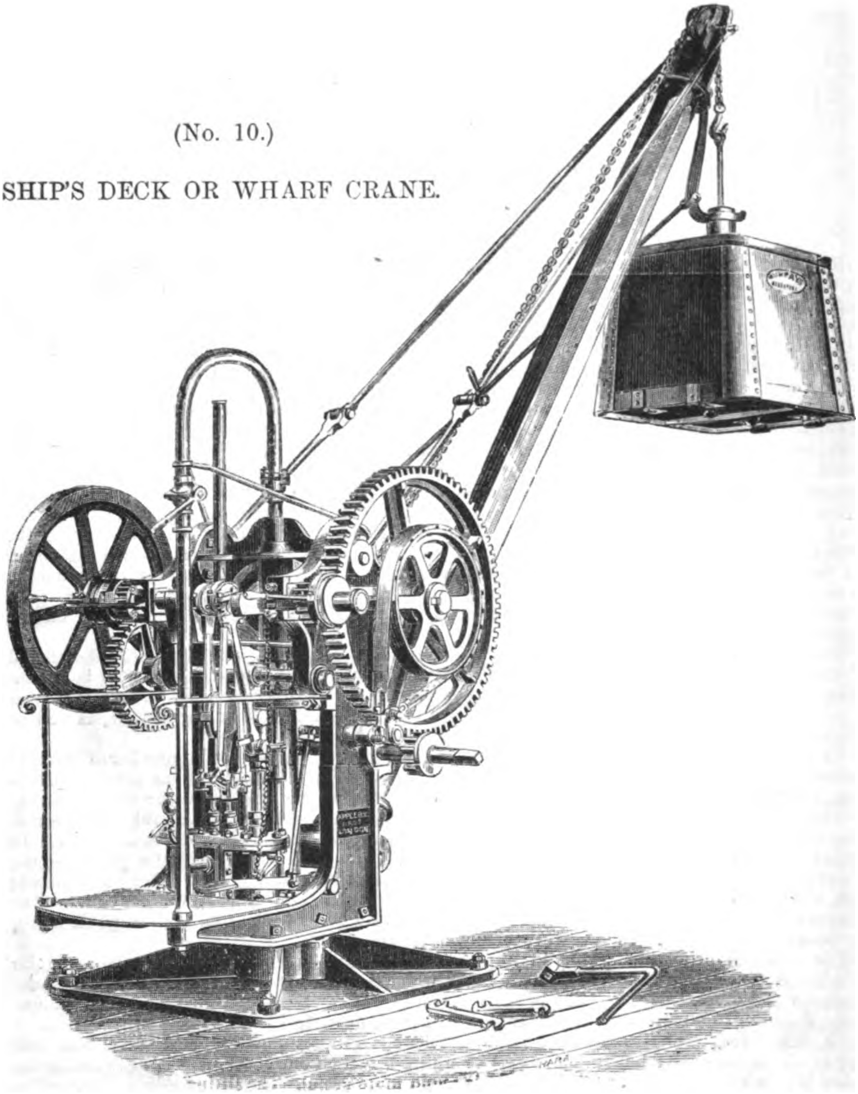
The Steam Winch, which forms the subject of our second illustration, is made with angular side frames fixed upon a strong iron base plate, which is bolted to the deck beams. The outer diameter of the winding barrel projects about 5 in. in front of the side frames, and this arrangement has been adopted to obtain a clear lead for a rope or chain in any direction, as well as to get a greater length of stroke for the engines. There is a capstan, or "surging barrel," on each end of the barrel-shaft; but in some cases a surging-barrel on one end, and a large drum on the other, for "whipping" coals or light goods, is found more useful. The lifting gear is arranged so that it can be worked in single or double purchase, either by steam or hand, and the proportions throughout are larger than usual in machinery of this class. The steam cylinders are 6 in. internal diameter by 10 in. stroke, and a large balanced disc-plate is keyed on to each end of the engine-shaft. The steam passages are cast in the side frames, the outer sides of which are faced to receive the cylinders, the inner sides being faced to receive the slide valves and jackets. By this arrangement space and weight are economized, and perfect rigidity is obtained.

These Cranes and Winches have been designed and made by Messrs. APPLEBY BROTHERS, at their London Works, and have been fitted to the whole of the steamers belonging to the Tees Steam Shipping Company, as well as to other vessels.

* See Crane No 10, p 28, and Winches Nos. 1 and 2, p. 29

(No. 10.)

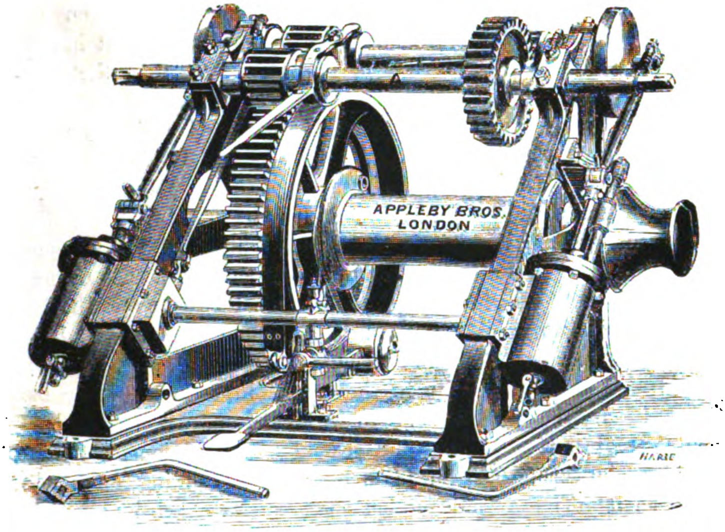
SHIP'S DECK OR WHARF CRANE.



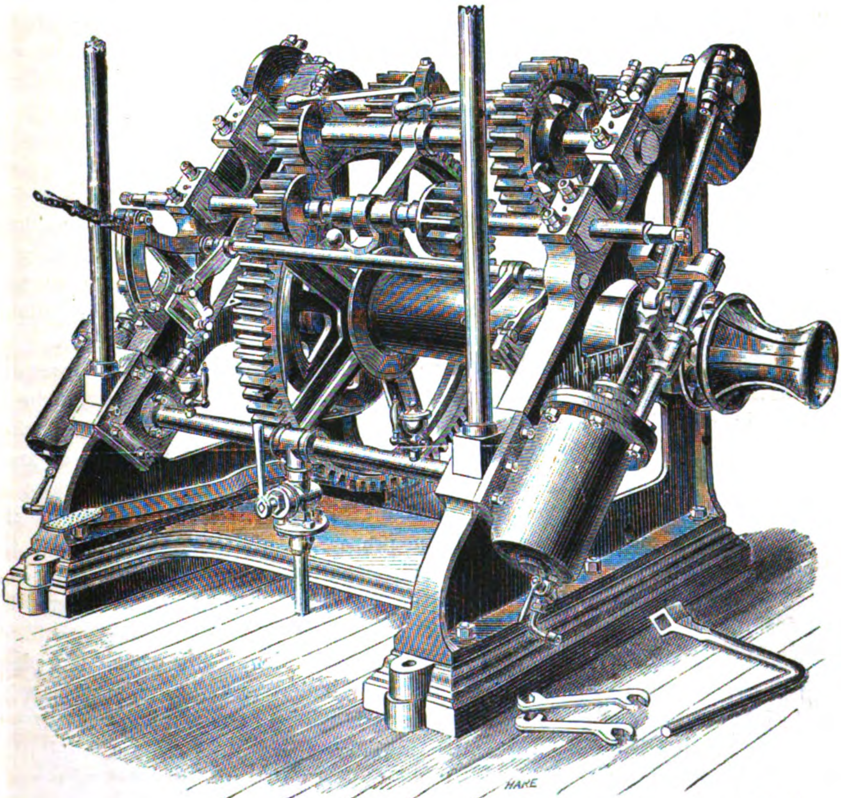
THESE Cranes are usually made to lift up to about 3 tons at slow speed, and up to 1½ tons at quick speed, with gear for turning round by steam; the latter is noiseless, and is arranged so that whatever "list" there may be on the vessel, the Crane Jib remains fixed in the position in which it is left. Ordinary light cargo is lowered by the break, and heavy or valuable goods are lowered by steam.

The Crane-post is hollow above the deck line, and the steam is taken through it to the cylinders; the exhaust is also carried through the crane post and led out to the ship's side; the inconvenience to passengers and crew, and the damage to cargo, so often arising from the escape of condensed water, is thus avoided. One boiler placed in any convenient position will supply steam to several cranes, and for long sea voyages the same boiler can be used for working the apparatus for distilling salt water, for cooking, and for the general supply of steam and hot water.

MURRAY'S PATENT SELF-DISCHARGING SKIPS, illustrated above.—For prices see p. 208.



STEAM WINCH, No. 1.



STEAM WINCH, No. 2., with Link Motions and extra Hand Shaft.

THE Steam Winch No. 1 was originally designed for use on board ship, for discharging cargo, working the windlass, pumps, &c. but it has been satisfactorily employed for a great variety of purposes other than that for which it was designed.

Each Winch has two cylinders bolted to the angular side frames, passages being formed through the frames with the slide jackets inside; this arrangement has been adopted to obtain a rather longer connecting rod than usual, and great stiffness with a moderate weight; the cylinders are fitted with metallic pistons, steel piston rods, and malleable cross-heads, each fitted with a gun-metal gland nut, to take up wear, and working on a round steel guide rod. The connecting rods are of wrought iron fitted with gun-metal hexagonal bearings at the lower ends, and cotters to take up wear, and with solid strap ends, gun-metal heads, and wrought-iron caps, turned bolts, and lock nuts at the upper ends. The disc plates are cast solid on the side opposite to the crank pin, to balance the pistons and connecting rods, and the crank pins are of wrought iron, case hardened.

The engine shaft carries the first and second motion pinions, which are flanged on both sides and made fast or loose by clutches sliding on steel feathers let into the shaft. The second motion shaft carries a third pinion like those described above, and a wheel keyed fast to it; this shaft is also fitted with handles to work the Winch by hand when desired; all the journals on these shafts are of great length, and are fitted with gun-metal bearings. The barrel shaft is turned throughout, and the barrel is keyed to it with steel keys. The large spur wheel is keyed on the end of the barrel, which relieves the shaft of torsion, and a turned break ring is cast solid with the wheel; the break strap is lined with hard wood and is fitted with apparatus to take up for wear, and with foot lever and pawl to hold the load suspended where required. The barrel shaft projects beyond the frames sufficiently to take a capstan end or "warping barrel" and chain wheel; but in many cases the Winches are fitted with the capstan end and chain wheel on one side, and with a pulley or "whip drum" on the other side. The barrel is made long enough to take any reasonable quantity of chain without overlapping; and being quite in front, the chain can be led away and travel on the barrel without fouling.

This Winch is *not* fitted with link motions, but provision is made for reversing the motion of the barrel by means of the gear. Supposing the engine to be running in one direction, the Winch will lift in the single purchase, and when the double purchase is thrown into gear it will lower slowly, which is of great importance when loading or discharging "wet goods" or valuable packages, or for bales and ordinary cargo the break may be used. When lifting in the double purchase, and the load is at the proper height, the reverse motion for lowering the chain is obtained by throwing the single purchase into gear, and this may be used in combination with the break, or the load may be lowered by the break.

Each Winch is fitted with hand-levers to each pinion, steam connection pipe, cock and lever, pet and grease cocks to the cylinders, and the exhaust may be taken over either side of the ship by simply removing a screwed plug.

With 2 Cylinders	**6 inches diameter will lift**	**3 tons.**	**Price**	**£90 0 0**
,, 2 ,,	**7 ,,**	**4 ,,**	**,,**	**£98 0 0**
,, 2 ,,	**8 ,,**	**5 ,,**	**,,**	**£110 0 0**

Link motions may be fitted to any Winch at £7 to £10 extra.

STEAM WINCH, No. 2.

The foregoing description will apply generally to the No. 1 Winch, illustrated at p. 30, but it is fitted with case hardened link motions, and an extra hand-shaft to work by hand in either single or double purchase, as shown. The exhaust can be taken away in vertical pipes or led to either side of the vessel as may be desired.

With	2 Cylinders	6 inches diameter	will lift	3	tons.	£98 0 0
,,	2 ,,	7	,,	4	,,	£110 0 0
,	2 ,,	8	,,	5	,,	£120 0 0

STEAM WINCH WITH PUMPS, No. 3.

Either of the Winches Nos. 1 or 2 can be fitted with two brass barrel pumps; for this purpose the second motion shaft is forged with a double crank in it, and the bed plate is cast with passages to receive the barrels and valves; a column is introduced between the cranks which stiffens the shaft by giving a central bearing, and at the same time serves as a capacious air-vessel.

The pumps can be arranged to pump from the Bilge fore or aft, or from the sea; they are therefore available for use as powerful fire-engines to work by hand or steam, as well as for washing decks, &c., and the extra price is, for

Two Brass Barrel Pumps	4 inches diameter,	fitted for	2 inch	delivery pipe,	£35 0 0
2 ,,	5	,,	$2\frac{1}{2}$	,,	£40 0 0
2 ,,	6	,,	3	,,	£45 0 0

For Suction and Delivery Pipes, see pp. 130, 182.

For Hose Unions, Connections, Hose Pipes, &c. see pp. 178, 180.

The approximate cost of Vertical Steam Boilers for supplying the Winches with steam (see p. 93), with mountings consisting of safety valve with graduated lever and weight, steam pressure gauge, water gauge, two gauge cocks, blow-off cock, man-hole, mud-holes and covers, wrought-iron furnace door and fittings, bearing ring, cast-iron furnace bars, ash pit, and one Appleby's Patent Steam Feed Pump, (illustrated and described at p. 113) is,

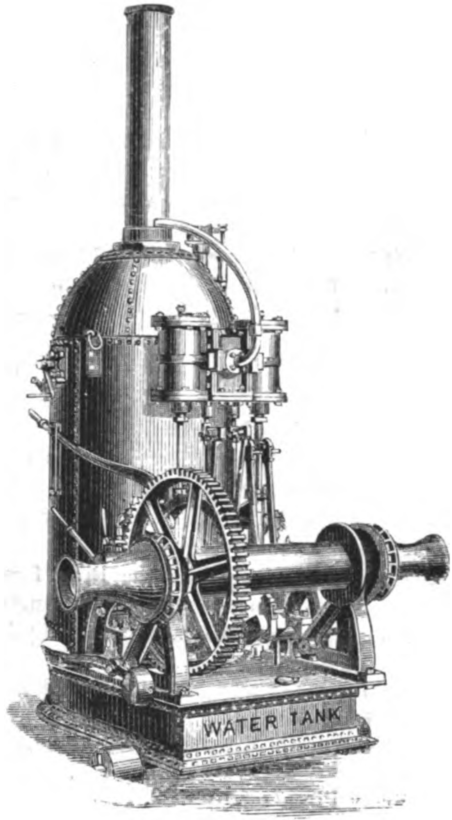
A Boiler for Two	3 ton	Steam Winches, price	£90 0 0
,, ,,	4	,, ,,	£100 0 0
,, ,,	5	,, ,	£115 0 0

If mounted on a strong wrought-iron feed water tank to protect the deck from the heat radiated from the boiler, about £15 extra.

A Single Cylinder Steam Winch to lift 1 ton in the single purchase, with case hardened link motions and capstan end, and shaft for working by hand, but otherwise similar in design to that illustrated at p. 33, price £75

Or, with boiler and mountings complete as specified above, price . . . £145

*** Apparatus for Distilling Salt Water, to be attached to the above Winches and Boilers, see p. .



(No. 13 B.) PORTABLE HOISTING, OR SHIP'S DECK ENGINE.

For a Ship's Deck Engine the carriage, or base, is used as a feed water tank, and is mounted on three small rollers, that at the back being made to swivel for moving the engine in any direction, and three strong wrought-iron rings are fastened to the Boiler for lifting the whole machine.

The hoisting gear is single and double purchase, with break apparatus, and the barrel shaft is fitted with a capstan and chain wheel for working the ship's pumps, lifting anchors, &c.

In some cases a powerful lift and force pump, or Fire Engine, working at 500 lbs. per square inch, is attached to the carriage and driven by a crank plate on the end of the barrel shaft. Provision is made for working by hand, if required.

For Contractors' use plain or flanged wheels are substituted for the small rollers, and adapted for any required gauge.

Double Cylinder Engines, as shown, but without Link Motions,

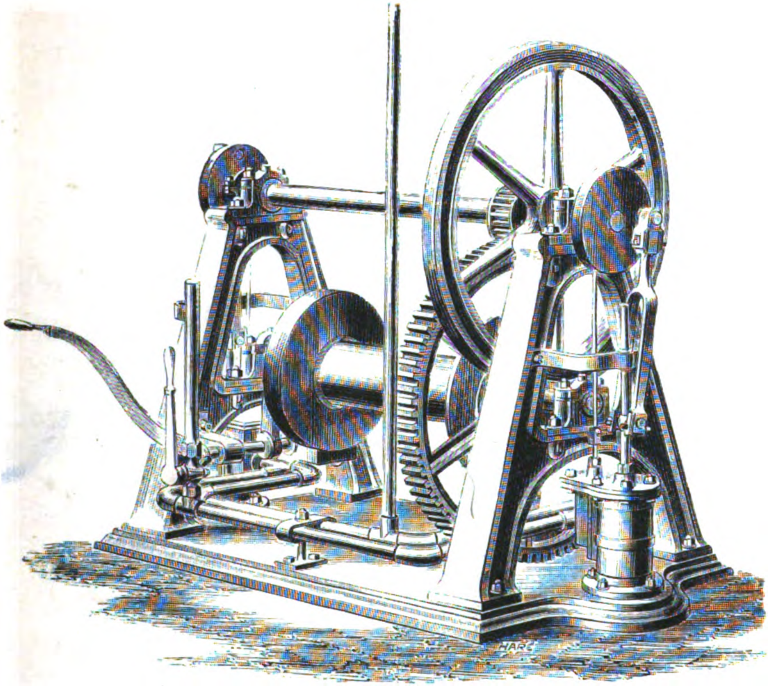
6-Horse power,	two 5½ Cylinders	. . . . . .	price £175	0	0
8 ,, ,,	two 6½ ,,	. . . . . .	,, 220	0	0
12 ,, ,,	two 7½ ,,	. . . . . .	,, 275	0	0

Single Cylinder Engines without Link Motions,

3-Horse power,	one 5½ Cylinder	. . . . . .	price £125	0	0
4 ,, ,,	one 6½ ,,	. . . . . .	,, 144	0	0
6 ,, ,,	one 7½ ,,	. . . . . .	,, 175	0	0
8 ,, ,,	one 9 ,,	. . . . . .	,, 190	0	0

Link motions for reversing, or for working expansively, £5 to £10 each extra.

If with two capstans, or one capstan and one large drum for "whipping" coals or cargo, £3 extra.

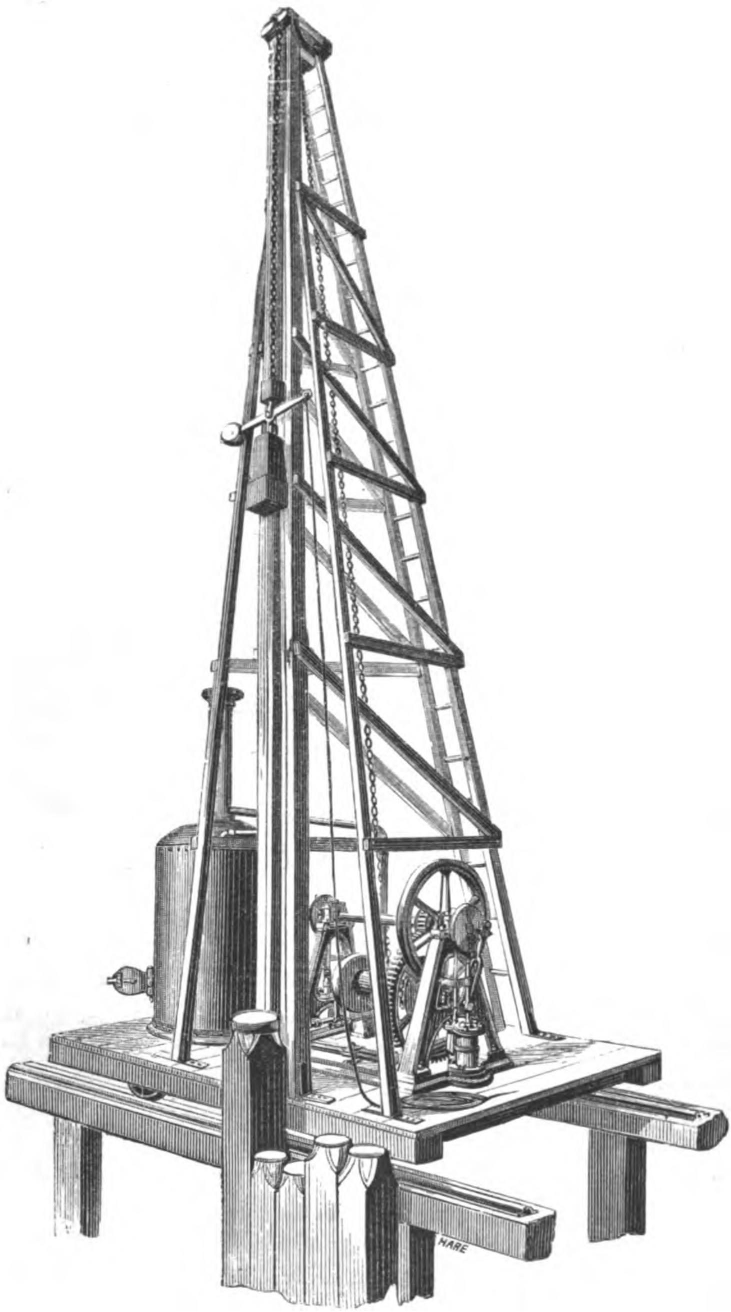


(No. 15.) APPLEBY'S FOUR-HORSE POWER SINGLE-PURCHASE STEAM CRAB, WITH TWO CYLINDERS

The above Crab is fitted with a pair of outside Cylinders and single purchase-gearing for lifting loads of up to 20 cwts. at a high speed, and to lower with the brake only; it is also extensively used as a Steam Pile Driver, with the ordinary Pile Engine frame. In some cases a number of crabs are worked from one stationary Boiler, and in others a small vertical Boiler is attached to each.

It is also adapted for hoisting purposes, with a Crane Jib, or blocks and falls, and when fitted with a pulley on the engine-shaft may be used for driving Pumps or any other Machinery.

Price of Crab complete, as shown	£75	0	0
Price of Crab with Boiler, and all furnace and steam fittings, steam feed pump and joints ready for connections between Crab and Boiler, ...	145	0	0
If with Strap Break on large wheel, with foot lever, and lever for throwing the pinion in and out of gear	7	10	0
Patent Nippers, 20 cwt. Monkey, Top Sheave and bearings, and 80 feet of $\frac{7}{16}$ inch best tested chain	20	0	0



(No. 15A.) APPLEBY'S IMPROVED STEAM PILE-DRIVING MACHINE.

(No. 15A.) APPLEBY'S IMPROVED STEAM PILE-DRIVING MACHINE.

THE advantages claimed for these machines are their cheapness, compactness and adaptability for a variety of work.

The boiler, which is of ample power and strength, may be mounted on the frame (as shown in the engraving), or it may be placed in any convenient position, and connected with the engine by a wrought iron pipe, with an improved form of gun-metal joint made for this purpose, to dispense with the flexible hose, which is liable to fracture unless used with great care.

This apparatus is frequently applied to the ordinary hand-piling engine in a few hours, and at little cost beyond that of the boiler and engine-work.

The general arrangement of the pile-driver is shown in the engraving, sufficiently to render it perfectly intelligible with the following short explanation.

The "monkey" or ram, and the chain, are the same as those used for the ordinary hand-engines; the "nippers" only, are specially adapted for the greater speed required when working by steam, so that the ram will make 10 strokes per minute, or less, in proportion to the fall required.

The machine may be set to drive piles at any convenient angle with its base, and the pile is pitched into its position for driving, by the chain in a very short time, without a rope.

As the ram will drive as low as the base of the engine, the "dolly" is not required.

The height of the machine is usually 35 feet, and will drive a pile 30 feet long; or a greater or less height is made to order.

The machine is mounted on plain or flanged wheels, as may be required, and they are slipped off the axles if it is wanted to work on a barge or pontoon.

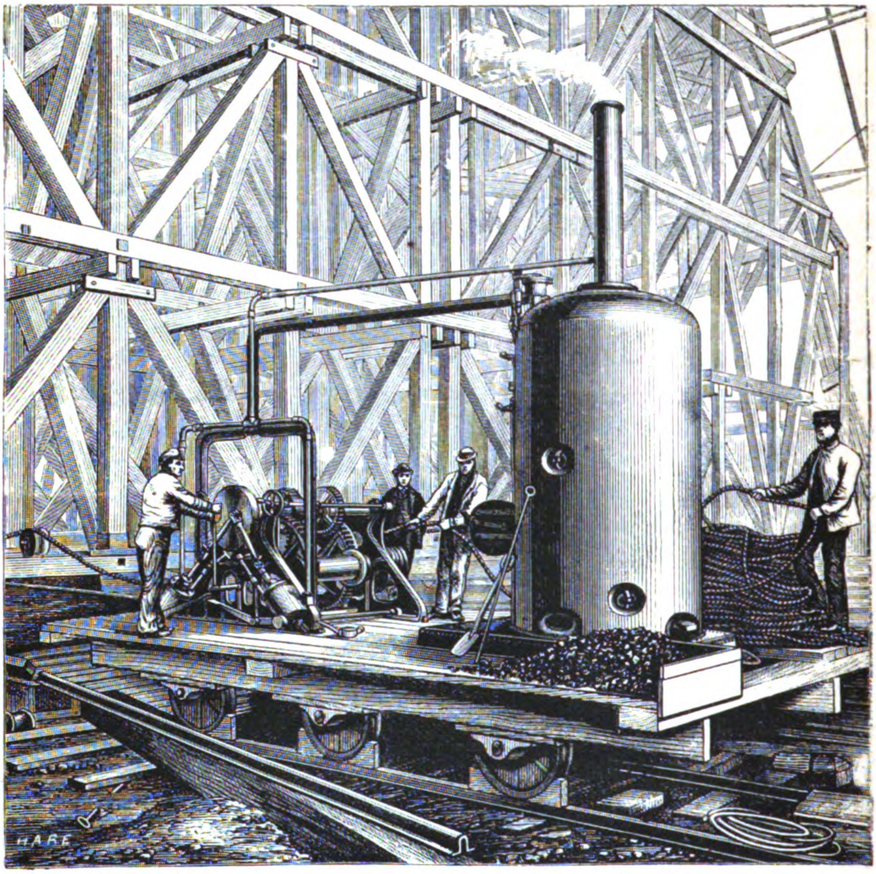
When the pile-driving is finished, the crabs are frequently used for hoisting barrows, building-materials, &c. or they may be fitted with jibs, and worked as cranes; or a pulley is fixed on the engine-shaft, for driving pumps, mortar-pans, saw-benches, &c.

There are few tools more generally useful for builders or contractors, and they may be seen in work for all the above-named purposes.

The weight of the steam pile-driving machine, but exclusive of woodwork, is about 3½ tons, and including the woodwork, complete as shown, about 6 tons.

Price	£195	0	0
Engine and boiler only, with steam connections	145	0	0
If fitted with Break on the large wheel, and foot lever, and lever for throwing the pinion in and out of gear, extra	7	10	0

Every Crab should have these extras, so as to make them available for pitching piles by steam, and for other work.



DUPLEX STEAM WINCH WITH TWO WARPING DRUMS AND TWO CHAIN BARRELS.

The Winch illustrated had to fulfil the same conditions as those used in the erection of the columns and roofs of the Exhibition buildings of 1851 and 1862, as well as the new Foreign Offices recently completed; but, profiting by the experience gained on the works above-named, the Authors designed and constructed the apparatus under consideration, for lifting the girders and iron work in the roof of the new Midland Railway Terminus in London, now nearly completed at St Pancras, by the Butterley Iron Company. The engraving is from a photograph which shows a portion of the staging employed in the work.

The apparatus is self-contained, and the two outside Warping Drums run at the same speed, but when these drums are not in use, either of the two chain barrels between (or inside) the frames can be used in either single or double purchase, and one may be lowering whilst the

other is lifting its load : this result is obtained by friction clutches for each motion, as well for facility, as for safety in the working.*

The cylinders are on the outer side of one Winch frame and at right angles with each other, the slide jackets being inside, and one pair of eccentrics work the two link motions; both of the connecting rods are coupled to one crank pin in the large balanced disc-plate which is keyed on the engine shaft. Two pinions on this shaft flanged up to the pitch line, are always in gear with the large spur wheels, and they are made fast or loose to the engine shaft by friction clutches worked by screws and hand-wheels; the double purchase is taken from two separate shafts, one for each barrel. The barrels are, as described above, inside the frames, and the shafts which carry them are left long enough to take the two Warping Drums for rope or chain; there is a connecting bar, or distance piece, with suitable bearings on the outer end of the shafts which carry the Warping Drums to distribute the strain on the drums equally between the two shafts. Each barrel is fitted with a separate break strap and foot lever; and all the levers are brought close together to be within the control of the driver.

These Winches are usually constructed to lift a maximum load of 3 tons direct from the barrel with a single chain, but they may be proportioned; and the Authors have made them to lift 6 tons or more without blocks; but as an almost unlimited length of rope may be used, and any amount of "nip" obtained by the use of the rope drums, it is perhaps preferable to use blocks for the heavy lifts instead of taking the power direct from the barrel.

The steam is supplied from a Vertical Boiler similar to that illustrated and described at p. 93, which, in addition to the usual furnace and steam fittings, has a steam Feed Pump, (see p. 113,) and is fixed on a wrought-iron feed water tank. The whole is mounted on a travelling platform with flanged wheels to run on a 4 ft. 8½ in. gauge, and it serves two stages of the kind as shown in the engraving; six tackles (three to each staging) are carried to every part of the staging, and the platform can be moved in either direction by making a rope fast on either side and passing it round the Warping Drums. The engine power is also used for driving a Punching and Shearing and Drilling Machine, which are fixed on the travelling platform.

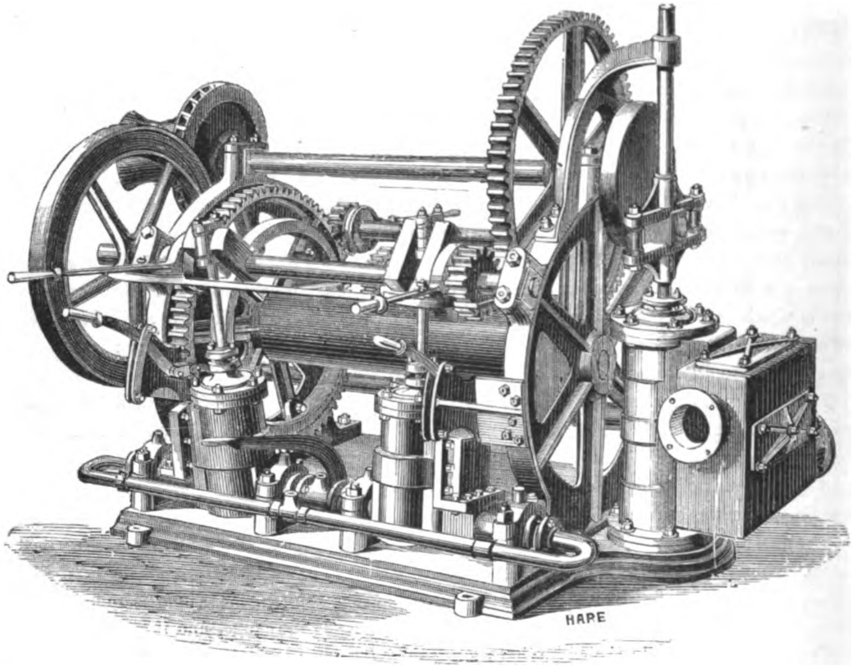
The approximate cost of the Winch and Boiler, with fittings and connexions for steam supply and exhaust, is. £280

Extra for Wheels, Axles, and ironwork for the Platform £30

Or the Travelling Platform with Winch, Boiler and connexions complete £330

The annexed engraving appeared in "ENGINEERING," of August 14, 1868, in connection with the drawings and description of the roof then being erected at the Midland Railway Station at St. Pancras, and is inserted in this work by the courtesy of the editor of that valuable journal.

* The Winches referred to as having been used in the Exhibition buildings had only the two Warping Drums, and could not be used as ordinary steam crabs or winches, and instead of being complete with their own engine power, a separate portable engine was required, the power being transmitted to the Winch by a strap.

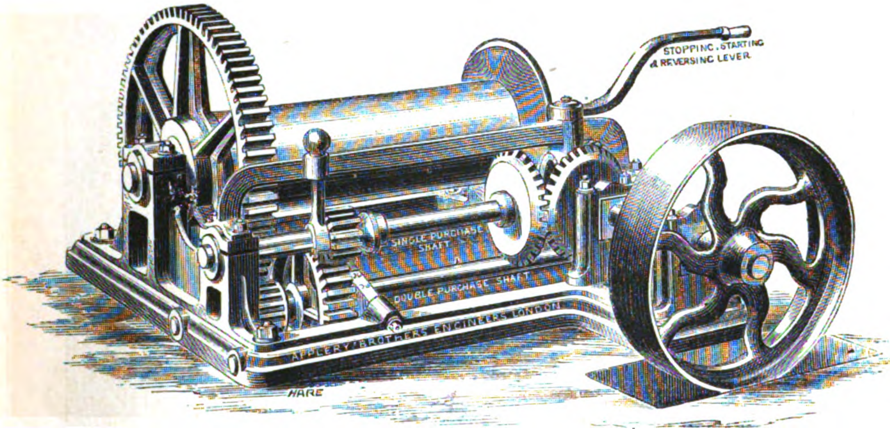


(No. 15 B.) STRONG DOUBLE PURCHASE STEAM CRAB OR WINCH, AND PUMPING ENGINE COMBINED.

The compact and powerful tool shown in the above engraving has two steam cylinders (with reversing motions) each $6\frac{1}{2}$ inches internal diameter, or = about 8 nominal horse power, single and double purchase lifting gear, with foot break, so that the load may be lowered by the break or by steam at pleasure, and the Winch may be worked by steam or by hand. There is on one side a powerful double-action lift and force-pump of 8 inches diameter, which will throw about 11,500 gallons of water per hour, in a continuous stream, and on the other side are two capstans, or warping barrels, both running at the same speed, or they may be made to work at different speeds, if necessary. The cylinders and gearing being placed within the side frames, which are bolted upon a strong iron base plate, the working parts are well protected, and the whole machine is moved about as easily as an ordinary hand crab, whilst for shipment it is packed in a case, complete and ready for work on arrival at its destination. These Winches are made without the pumps, but with capstans on each side instead of on one side only, as shown, and they have been made with two pumps of the kind described. They have also been fitted with powerful air pumps for supplying air in diving bells, caisson sinking, &c. at the time the load is being raised or lowered, and whilst the men are at work below.

The end of the crank shaft is left free to take a pulley for driving machinery, and the fly-wheel is turned on the rim.

Enquiries for prices should be accompanied by information, as to the particular arrangement required, and details of work to be done.



BUILDER'S HOIST DRIVEN BY STRAP.

Motion is given to the apparatus by a strap driven from the pulley of an ordinary portable Engine, or any other available power.

The Engine being required to run continuously in one direction, the reversing motion for lifting and lowering is obtained from the eccentric lever, which works a pair of friction clutches and a set of mitre wheels. For lifting loads of up to 10 cwt. at high speeds, the single purchase is used, and with the double purchase, loads up to 40 cwt. are lifted with the single chain. If required for heavier work, blocks are used, there being ample length of barrel for a large quantity of chain. The shafts are all turned, and run in gun metal bearings, and the whole is carried on a strong iron base plate, with bolts for securing it to timbers or a more permanent foundation, and the machine is got up throughout in the same style as the best Engine work.

When an Engine is used for grinding mortar, sawing, pumping, &c., the Hoist is placed in any convenient position, and the chain is led off by leading blocks in the direction from time to time required.

As the Engine is running continuously, when a lift is required the men move the lever to one side or other, as required, so that a special attendant at the Hoist can be dispensed with, excepting when it is worked throughout the day, as it will be when used for hoisting bricks, &c. with the double chain, as described at p. 22.

These Hoists have hitherto been made of one size, the price of which is £50, but larger or smaller machines can be made if necessary.

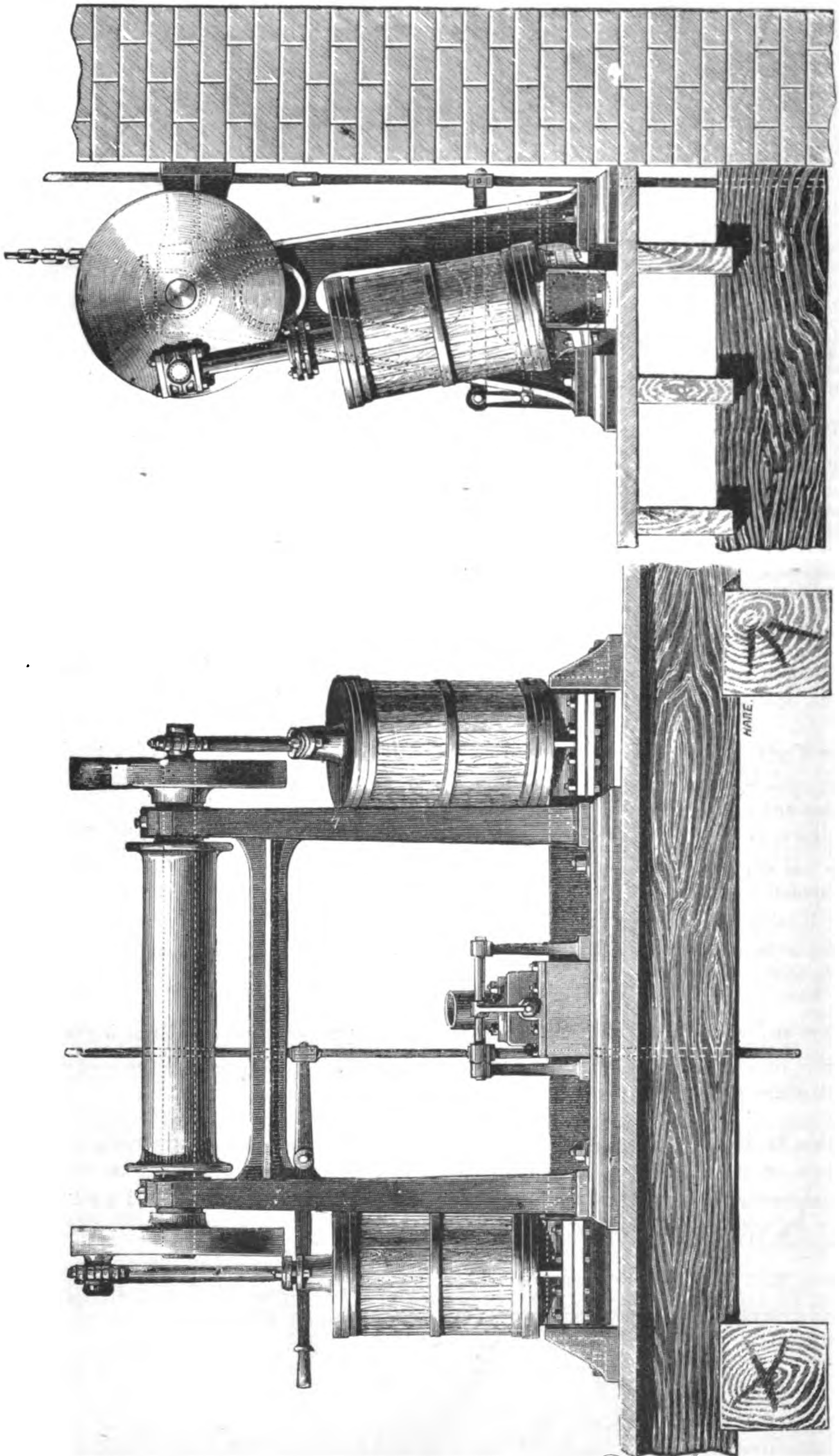


FIG. 1. FIG. 2.

DIRECT-ACTING CRANE OR HOIST. *(For Description, see opposite page.)*

DIRECT-ACTING CRANE OR HOIST, WORKED BY STEAM, WATER, OR COMPRESSED AIR.

Fig. 1 is a side elevation, and Fig. 2 an end elevation, of an improved arrangement of hoisting apparatus for use in warehouses, factories, &c., to be fixed against a wall, but it can be made to fix in any other position if more convenient.

The Crane consists of a pair of vibrating cylinders, proportioned in each case to the pressure available and the maximum weight to be lifted; the pistons of these cylinders are coupled direct to the disc plates on the ends of the chain barrel shaft; the motive power, whether steam or compressed air, is conveyed to the cylinders by a pipe as shown, and the cut off is obtained by the oscillation of the cylinders on the trunnions; an ordinary D valve, placed centrally between the standards and worked by a weigh shaft and lever, closes or reverses the passages, and causes the Engine to stop or travel in either direction as required.

In buildings where the hoisting gear has to be worked on any floor, a rod is attached to the slide valve lever, and is carried through the several floors to the height required.

The machinery can be fixed in any convenient position, and the chain led over the pulley of an ordinary crane jib, as illustrated at p. 63.

Or it may be used for working a warehouse lift, and it is found very economical and safe for that purpose.

Where steam is used, the boiler may be in the basement or away from the building, and one or a number of hoists may be worked from one boiler.

Where low pressure water pressure is used, a tank at the top of the building supplies ample pressure; and in other places, where a steam engine, turbine, or other prime mover is employed, a small air pump may be fixed and the compressed air carried in pipes to any distance; in some businesses, where using steam power in the building would affect the rate of insurance, the latter arrangement is most convenient, and the exhaust air from the cylinders may be used as a means for increasing the supply of pure air in the room.

The advantages clearly obtained by this system are,—

High speed of working. Safety in lifting and lowering; all gear, breaks, and clutches being dispensed with. Absence of noise in working. Simplicity of action, only one lever being used for all motions. Non-liability to get out of repair.

With a pressure of about 50 lbs. per square inch the approximate prices of these hoists are—

To lift ½ Ton, Price £60; 1 Ton, £80; 2 Tons, £120.

But these prices will be greatly modified as the conditions of working are varied, and all enquiries for prices of hoists to be worked from an existing pressure, should be accompanied by ample details as to—

The pressure available in lbs. per square inch, or the head of water in feet, *vertical height*. The maximum load to be lifted. The maximum height of lift.

When a pressure of 100 lbs. per square inch or more can be obtained a slightly different arrangement is adopted. A pair of cylinders, fitted with hydraulic leathers in the working parts, are arranged either vertically or horizontally on one base plate, and are either coupled to the winding drum, or drive through a countershaft by means of a wheel and pinion, as may be most convenient. There is no clutch or break, one lever giving all motions of lifting, lowering, stopping, or holding the load suspended.

This arrangement is especially useful where water can be obtained at a cheap rate, or where circumstances are adverse to the use of steam power, and even where water has to be purchased, if it can be used for other purposes after passing through the water engines, the power is almost costless.

These engines work well at any speed up to about 120 revolutions per minute, and they are used for working all kinds of small machinery, such as Printing Machines, Lathes, Malt Crushers, Chaff Cutters, &c. &c. as well as for Hoisting Machinery.

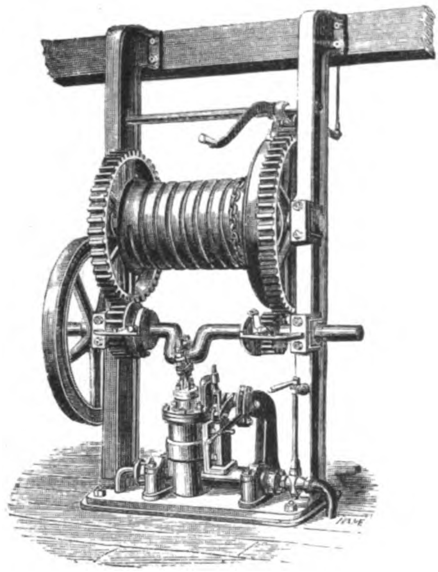
The prices of the Engines ready for connecting to any work are—

Diameter of Cylinder	2	2½	3	3	3½	4	4	6 inch.
Length of Stroke .	4½	10	6	9	9	9	18	18 inch.
Price . . .	£15 10	£20	£26 10	£30	£36	£48	£72	£95

When the water is used from the street mains an equilibrium water-meter should be used, which registers the quantity of water used without diminishing the pressure. The prices of these, with Dirt Boxes and Couplings, are—

Diam.	½	¾	1	1½	2	3	4	5	6		10	12 inch.
Price	£3	£5 10	£6 8/6	£9 5	£11 12/6	£17 10	£22 10	£28	£35	£50	£67	£89 10

(No. 17.) STEAM WAREHOUSE CRANE.



THIS compact and simple Crane is fitted with a Steam Cylinder, the vibrating motion of which is employed in connection with a Quadrant and Lever, to work the Slide Valve and reverse the Engine, so as to lift or lower by steam—the latter being particularly important when valuable packages or "wet goods" have to be lowered.—Quick and slow speeds of lifting gear are provided for light and heavy goods, and a powerful strap break for lowering loads quickly is provided, which may be worked either at the Crane or on any of the various floors. The Piston can be readily disconnected from the Crank shaft, and being fitted with Fly wheel and handles, the Crane can be worked by hand.

The whole of the Machinery is carried in strong iron sides, fitted with gun-metal bearings, and bolted to an iron base-plate. A number of Cranes may be worked from one Boiler, and each Crane may be worked separately.

THE BOILER is usually placed outside, or in the basement of the warehouse or building; and the steam pipes only being carried into the building, there is no risk of fire; but in many of the warehouses in large towns, the most recent practice is to generate steam by means of Gas, in which case an APPLEBY'S PATENT GAS BOILER may be advantageously employed.

In some instances these Cranes are worked by water power; and there are few well-constructed hand Cranes which cannot be converted to work by steam or by water. (See page 41.)

Although it is impossible to give a general estimate for work of this character, which is ever varying in detail, the subjoined figures may be useful for the purpose of calculation.

One Steam Warehouse Crane to lift 20 Cwts.	£65	0	0
One Steam Boiler for same ,, ,, ...	50	0	0
Suppose with Chain for 40ft. Lift, Hook, Balance Ball, and Radius Piece	7	10	0

The cost of Steam connections will vary according to position.

For prices of jibs, see p. 64. For the cost of working Steam Cranes, see p. 2, &c.

But where a number of Cranes are required, these figures will necessarily be considerably modified. It is frequently convenient to drive several Cranes from a line of shaft worked by one Engine or Turbine; and several examples of this arrangement may be seen in operation in London and elsewhere, in some instances with frictional Gear (see p. 43), and in others by friction Cones, which the authors have used rather extensively, and with highly economical working results.

PATENT FRICTIONAL GEARING HOISTS,

FOR WAREHOUSES, FACTORIES, &c.

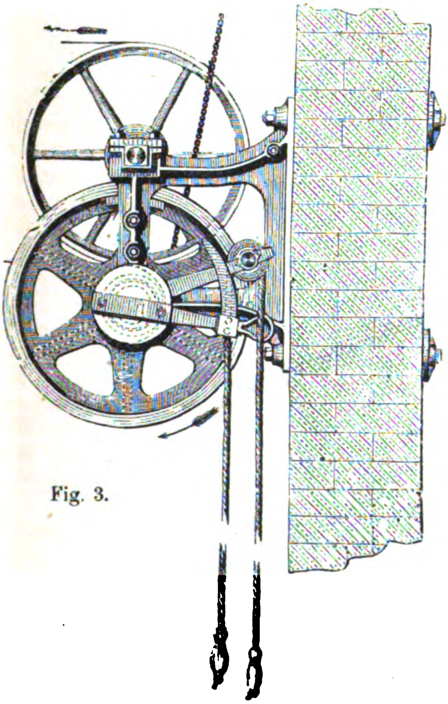


Fig. 3.

THESE Hoists are simple and durable, easily worked, safe in action, noiseless in working, and only ONE lever is required for throwing the Lifts into and out of gear, and for putting on the Break.

This lever is worked at the Lift itself, or on any Floor, by means of a Cord extending from top to bottom of the Warehouse, and the Break can at any time be made SELF-ACTING, so that the load will be stopped whether the man in charge attends to it or not. This arrangement is very important as a safeguard under any circumstances.

A number of the lifts may be driven off one shaft, or each Lift may be driven by a separate strap, as shown in Figs. 3 and 4.

These Hoists may be adapted to work by hand whenever desired (as for instance, if a few loads have to be lifted when the Engine is not working) and they may be fitted to a wall as shown, or fixed down to a floor, or up to a ceiling, without alteration.

The Patent Frictional Gearing Hoists are made to lift from 2cwt. to 30 cwt. at a high speed by single purchase, and for heavier weights they are fitted with double or treble purchase, as required.

Prices and all particulars will be forwarded on application, if accompanied by information as to whether the Lift is to work through a "Well Hole" or over a Jib, the maximum weight to be lifted and the position of the Barrel relatively with the Jib or other appliance.

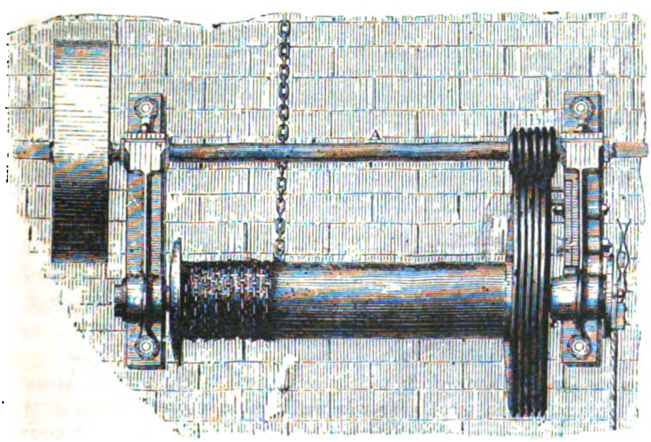
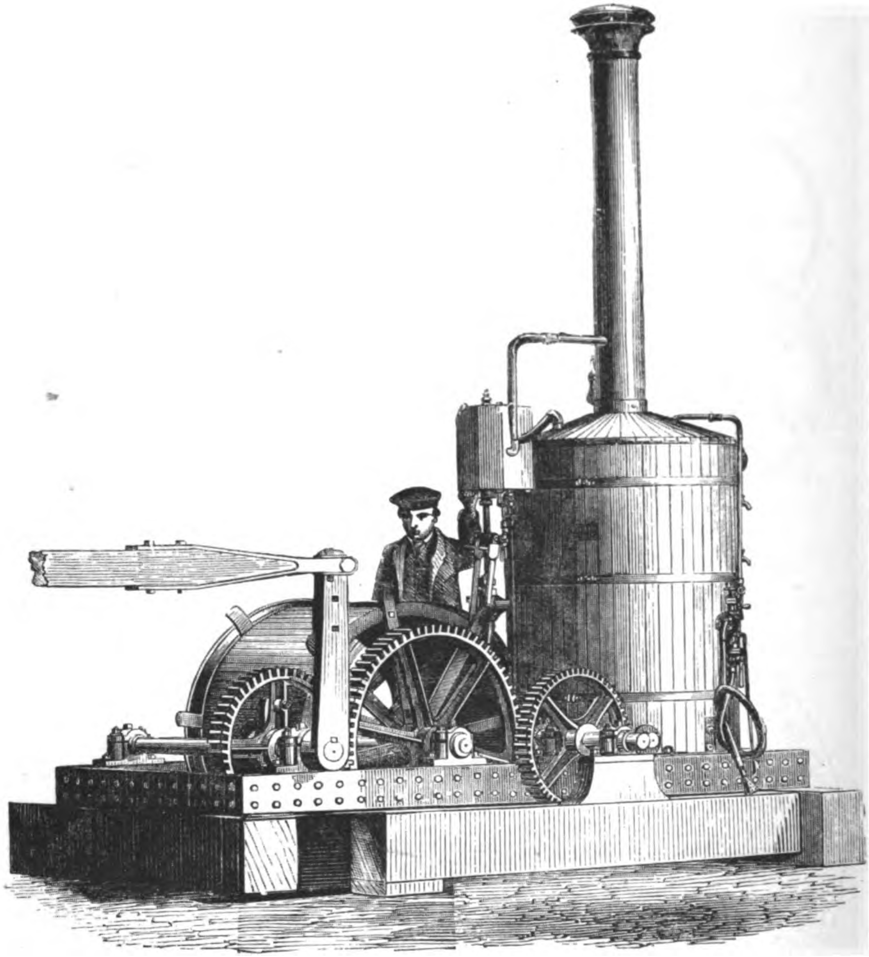


Fig. 4.



(No. 16.) WINDING AND PUMPING ENGINE FOR PIT-SINKING. INCLINES, &c.

THE Boiler with all fittings, the Engine with reversing motions, and the Gearing with foot break, are mounted on a strong iron frame, and the whole can be readily removed: the Drum is made with wrought-iron arms and wood lagging for any kind of rope, and has been speeded to run, according to circumstances, at from 50 to 300 feet per minute, and the pumping gear from 8 to 40 strokes per minute.

Although originally made for small workings widely separated, where manual labour was expensive, and where a large outlay in machinery was undesirable, these Engines have been found to give such satisfactory working results that they have been made of almost every size from 3 to 20-horse power (nominal). The subjoined prices are for the sizes usually made :—

3-horse power complete, with force pump and all fittings		. . .	£165
4-horse	ditto	ditto	190
7-horse	ditto	ditto	225

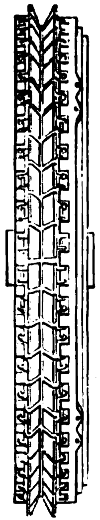


Fig. 1.

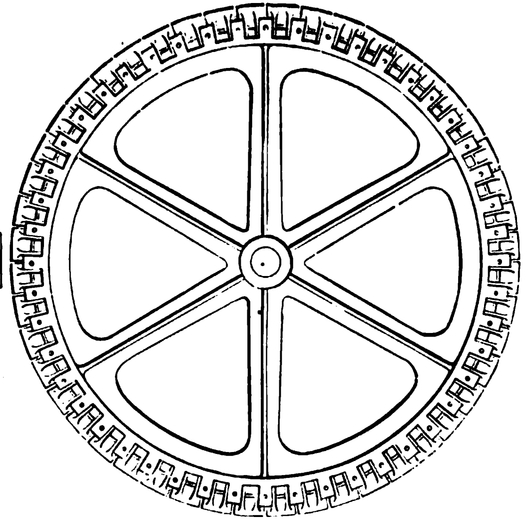


Fig. 2.

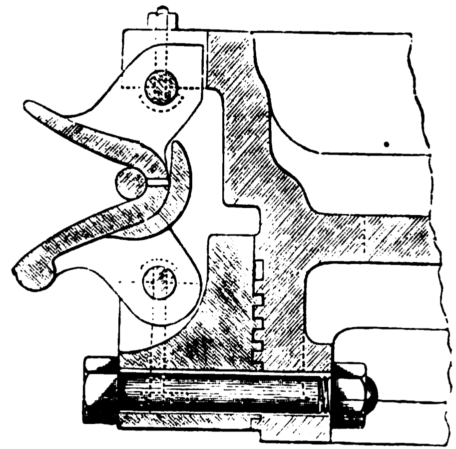


Fig. 3.

FOWLER'S PATENT CLIP PULLEY OR DRUM

Has been designed principally for transmitting power at a distance, and for working economically with Steel Wire Rope. It is employed most successfully for steam ploughing, and is now much used for mining and haulage purposes. The form of the Clips is such that great power is obtained with very little friction or wear and tear upon the rope, and consequently less danger of breakage, as its action tends to distribute the load equally through the wires, and less rope is required than with the ordinary coiling drums.

Figs. 1 and 2 represent the complete Pulley, and Fig. 3 the section of the same in detail. It can be mounted either vertically or horizontally, but preference is given to a vertical position as the best in practice.

Prices of Clip Pulleys or Drums :—

Diameter	4	5	6	7	8 feet.
Price	£35	£50	£60	£75	£90 each.

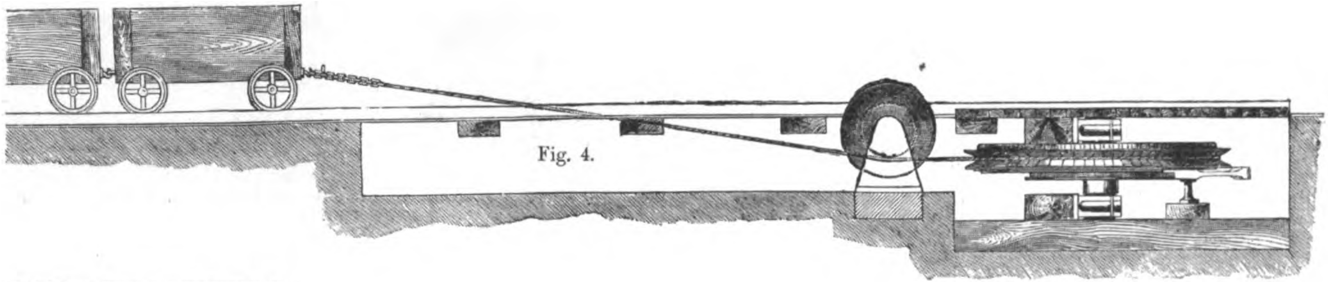


Fig. 4.

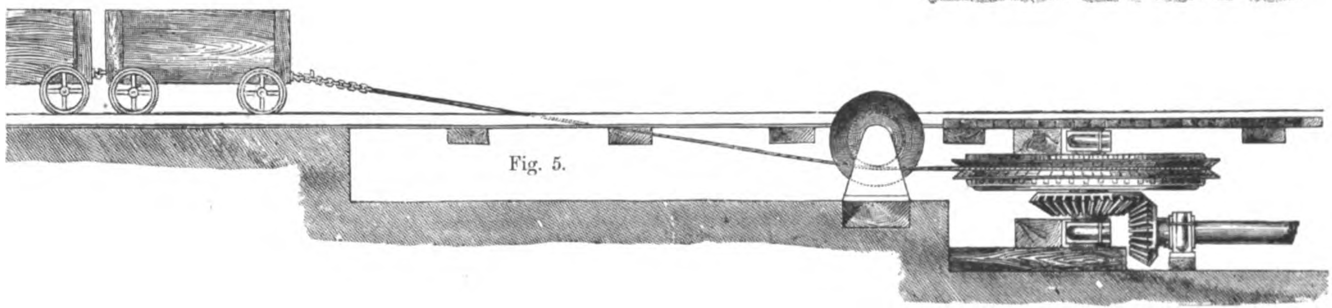


Fig. 5.

FOWLER'S PATENT CLIP PULLEYS OR DRUMS—*continued.*

Fig. 4 shows the Pulley arranged for a self-acting incline, where the EMPTIES ascend and the FULL trucks descend by their own weight. A powerful brake is attached which gives complete control over the rope, so that the waggons may be stopped instantly; or in case the rope should break, one set of waggons can be held.

Fig. 5 shows a partially self-acting incline where the FULL trucks have to come up, and the EMPTY ones down; this necessitates the use of engine or other power to overcome the difference in the load.

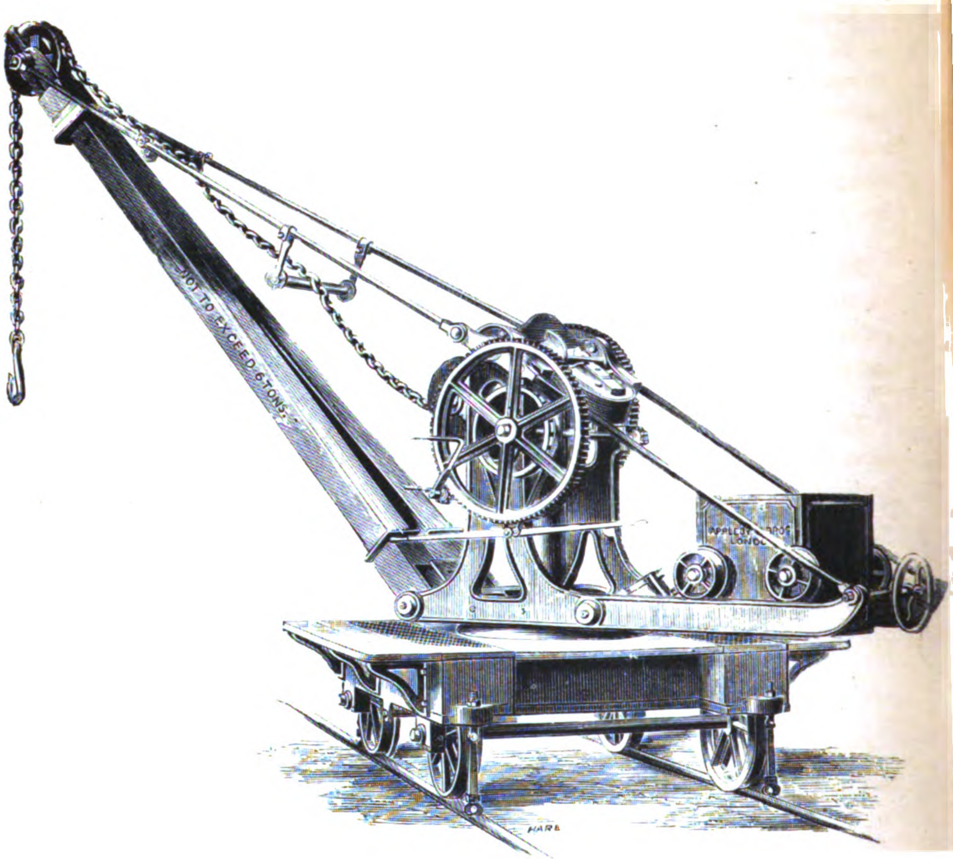
The PATENT CLIP PULLEY OR DRUM is applicable to a great variety of purposes in hauling, hoisting, pumping, &c., but as each case usually requires some special arrangement of details, it is best to send full particulars of the work to be done, and sketches of the position in which it would have to be fixed.

HAND CRANES,

TRAVELLERS, CRABS,

AND

HAND HOISTING MACHINERY.



(No. 1.) PORTABLE HAND CRANE, GOVERNMENT PATTERN.

These Cranes are constructed to lift weights varying from 3 tons to 10 tons, and can be adapted to any gauge of rails from 4 ft. 8½ in. to 7 ft. and they have hitherto been made by the authors principally for her Majesty's Government. The base plate is of cast iron in one casting, and the conical roller path is turned on the face, the travelling wheels are also turned up on their faces, and the axle journals are fitted with gun-metal bearings.

The crane post is of hammered iron, and all the wheels and pinions of the lifting gear are lined up to their pitch lines on both sides, the pinions being thrown in and out of gear by levers and clutches.

The second motion shaft is fitted with a strap break, wood lined, with balanced lever and regulating screw, wrought iron pawl wheel and pawl ; the journals throughout are of great length, and run in gun-metal bearings.

The jib is formed of two pieces of hard wood, fitted into a casting which carries at the jib-head a chain sheave of large diameter bushed with gun-metal; the timbers forming the jib are splayed out and fitted into suitable sockets at the bottom, and between them is a turned friction wheel which takes the thrust of the jib and reduces the friction in turning. The tie rods are of very ample section and continuous to the end of the tail-pieces which carry the balance weight box; rollers are provided for carrying the slack chain as shown, which is then easily overhauled.

The balance weight box is of ample size, and is fitted with tram wheels to run on the tail-pieces and traversing screw with hand wheel. There is a turned friction roller to take the weight of the balance box, and one to reduce the friction at the top of the crane post.

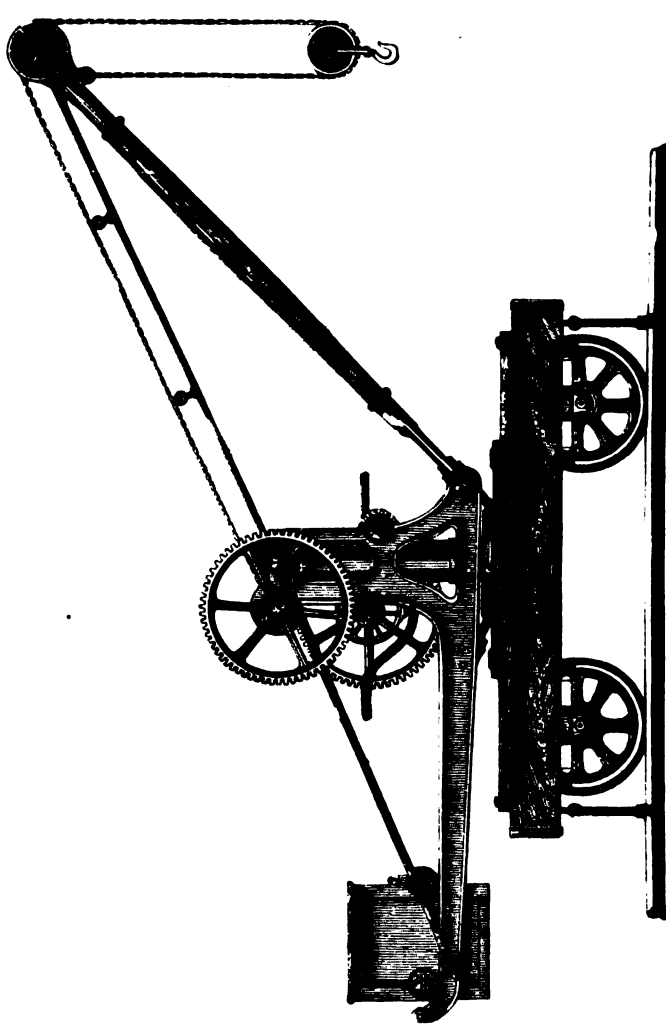
The base plate is chequered on the upper surface, and forms a platform of sufficient size to allow the men to work at whatever angle the Crane may be, and clamping dogs are provided to hold the carriage down to the rails if required:

					£	s.	d.
No. 1.	to lift	3	tons	Price	130	0	0
No. 2.	„	4	„	„	145	0	0
No. 3.	„	5	„	„	205	0	0
No. 4.	„	6	„	„	270	0	0
No. 5.	„	10	„	„	350	0	0

Cranes of the foregoing description, but with wrought iron or hard wood frames, and fitted with bumper blocks and couplings to run with permanent way stock:

					£	s.	d.
No. 1.	to lift	3	tons	Price	135	0	0
No. 2.	„	4	„	„	150	0	0
No. 3.	„	5	„	„	212	0	0
No. 4.	„	6	„	„	278	0	0
No. 5.	„	10	„	„	360	0	0

The best class of PERMANENT WAY CRANES are made with wrought iron frames, patent axle boxes, springs, spring buffers, and spring draw bars, and they are fitted with screws to render them rigid when the load is being lifted. These are usually supplied with a Tender containing Jacks, Packings, and Tool chests, and with a place to hold the jib and the shear legs when travelling. Cranes of this description are made for the heaviest kind of work, and usually to special designs and quotations.



No. 2. PERMANENT WAY CRANE FOR RAILWAYS OR ROADS.

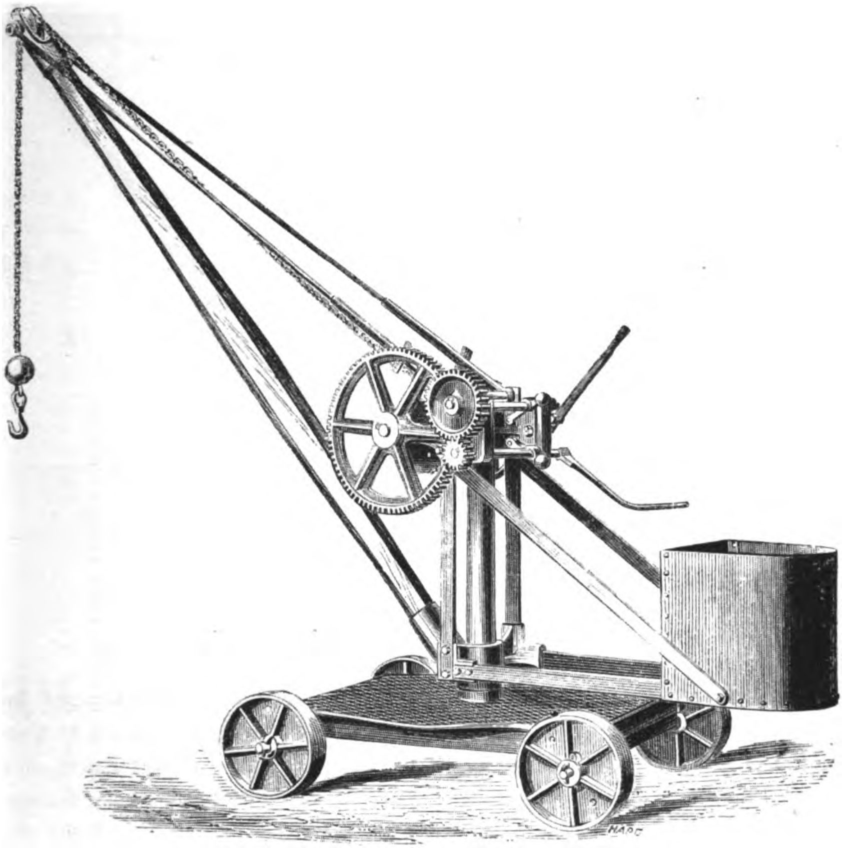
THIS Crane is fitted with single and double purchase lifting gear, strap break and lever, and a balance box, with apparatus for adjusting it according to the weight of the load. The frame of the travelling carriage is made of timber, and mounted on cast-iron wheels with wrought-iron axles.

To lift 2 Tons	Price	£90	0	0
„ 3 Tons	„	120	0	0
„ 5 Tons	„	180	0	0
„ 7 Tons	„	240	0	0

No. 3. LIGHT TWO TONS CONTRACTORS' PORTABLE HAND CRANE.

THIS Crane is fitted with single and double purchase-gearing, strap break, ratchet, and pawl for holding the load. The column is of wrought-iron, and the Crane swings entirely round upon it, and a plate is provided for the counterbalance weight at the back.

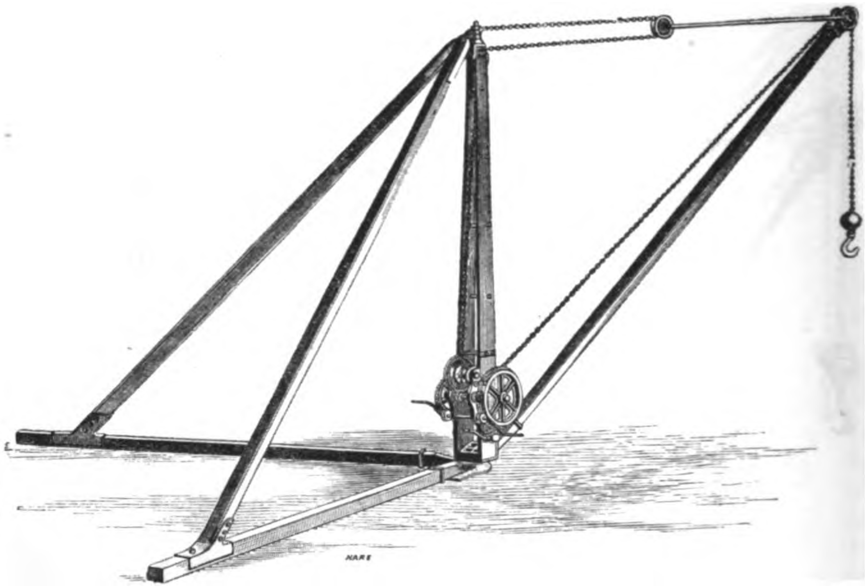
Complete, with 35 feet of best tested Crane chain and hook, suitable for 4′ 8½″ gauge	Price £47	10	0
Ditto, ditto, for 7′ 0″ gauge	„ 50	0	0
An extra set of plain wheels	„	10	0



(No. 4.) LIGHT PORTABLE CRANE.

The base plate is of cast-iron, chequered on the upper surface to form a man-stand, and is mounted on plain or flanged travelling wheels with wrought-iron axles; the Crane post, sides, tail pieces, balance weight box, and tie bars, are all of wrought-iron, and the latter are frequently made to fasten with cotters and slots, as shown, to allow the jib to be lowered for passing through an ordinary doorway. The Crane can be turned entirely round, and the lifting gear is fitted for working in single and double purchase, and has a break apparatus for lowering quickly.

To lift ½ Ton, complete with chain to ground line and balance ball.				*Price* £36
To lift 1 Ton,	ditto	ditto	ditto	*Price* £45.
To lift 2 Tons,	ditto	ditto	ditto	*Price* £55.



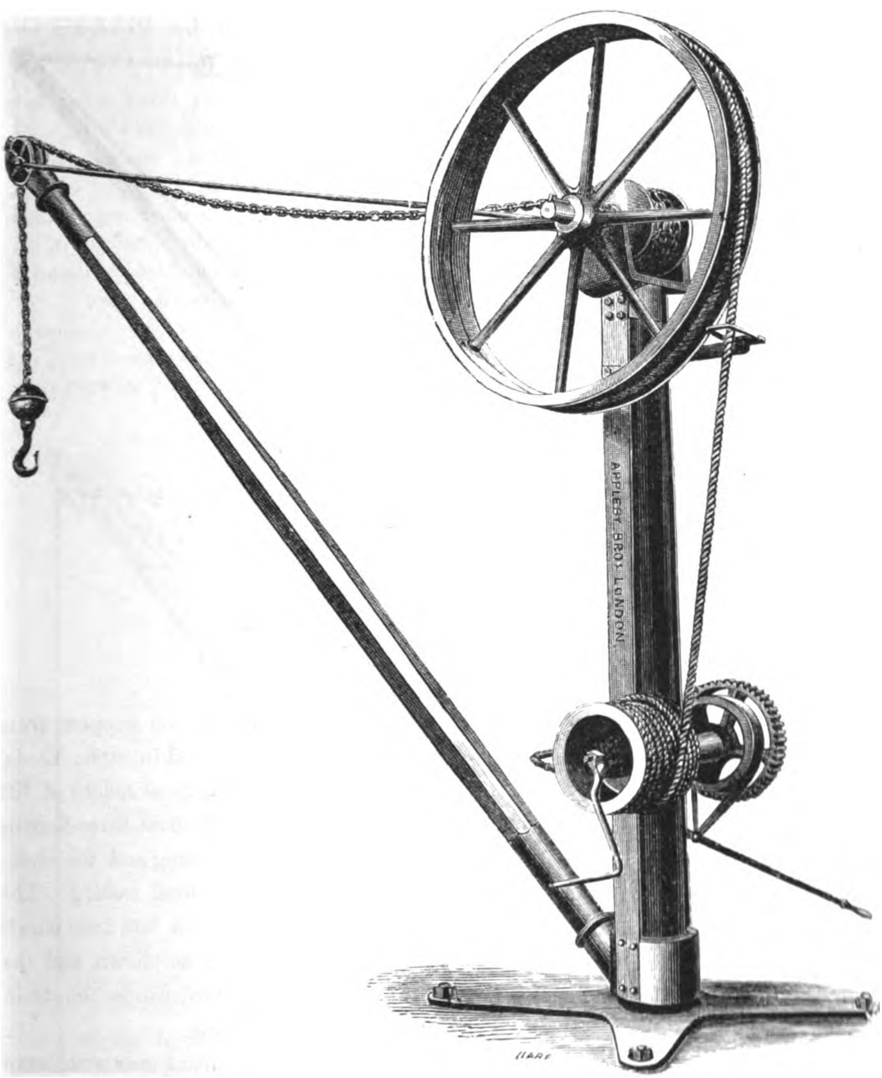
(No. 1.) HAND DERRICK CRANE.

Being moderate in first cost, easily moved, and requiring no support from buildings, or great care in fixing, these Cranes are extensively used in Stone Yards, in constructive operations, and generally in situations where a great height of lift and varying radius is required. They are made to swing round about three-fourths of a circle. The gear is fixed at a convenient height for turning, and the chain passes direct from the lifting-barrel over a pulley in the Jib head casting. The radius of the Jib is varied by turning the Derrick-barrel (see also p. 23), from which a chain runs between the Crane sides over a pulley at the top, as shewn, and the arrangement is such that the load lifted, nearly or quite counter-balances the strain on the gear, so that little harm can result from careless working.

The subjoined prices include single and double purchase lifting-gear with strap break, and lever, two handles, the safety Derrick motion described above, the whole the timbers shewn, with all necessary shoes and Ironwork, together with chain to reach to the ground line.

To lift.	10 Cwt.	1 Ton.	2 Tons.	4 Tons.	6 Tons.	10 Tons.
Sweep 30 ft.	£20	£30 10*s.*	£45	£75	£120	£200

The approximate extra price for ***each additional five feet*** of sweep will be about 10 per cent. on the above. Thus, for Crane 40ft. sweep to lift 4 tons, add 10 per cent to £75=£82 10*s.* 0*d.*, and 10 per cent again=£90 15*s.* 0*d.*



(No. 2.) INDEPENDENT WHIP CRANE.

THIS Crane was originally designed for the CENTRAL ARGENTINE RAILWAY, where the Goods Sheds were lofty, and the roofs so light in construction that no support could be obtained at the top, but it is equally suitable for Docks and other places where light weights have to be lifted quickly.

It stands quite independent of any support, swings completely round, and is fitted with three "purchases" or speeds of lifting, break apparatus, &c. Weights up to about 5 Cwt. are lifted quickly by pulling directly at the rope; for working loads up to 1 Ton the handle is put on the rope-barrel shaft, and, for heavier loads, on the pinion shaft.

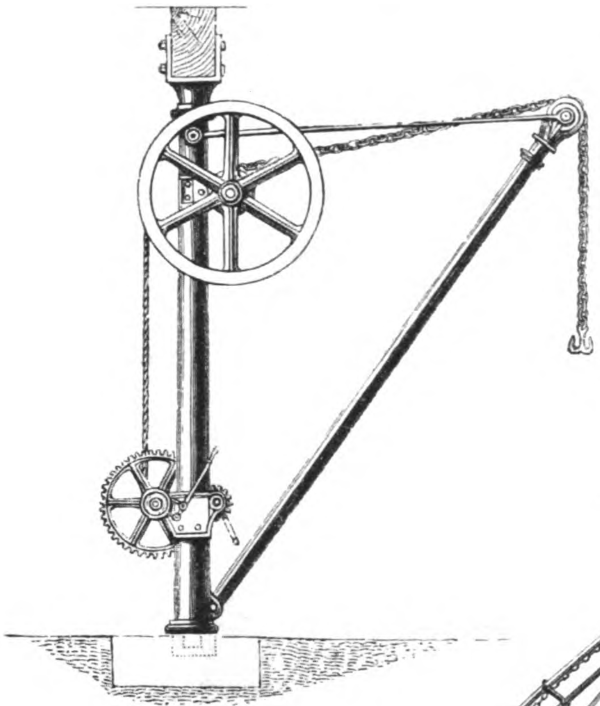
PRICE OF THE CRANE COMPLETE AS SHOWN.

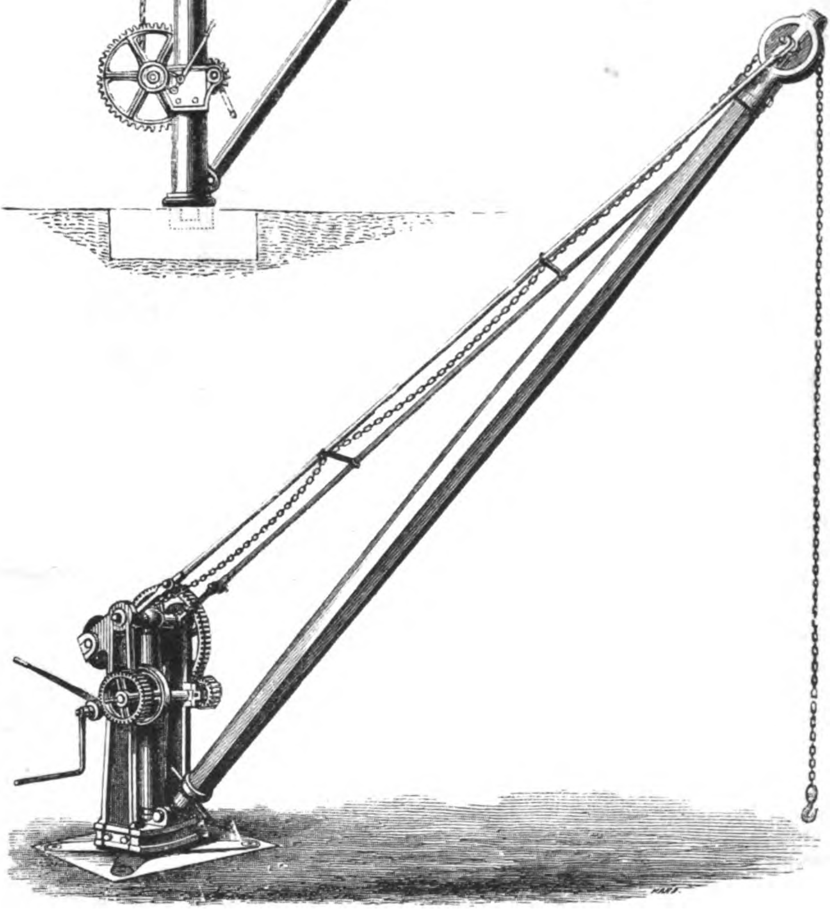
	£	s.	d.
To lift a maximum weight of 1 Ton	45	0	0
" 2	52	0	0
" 3	63	0	0

No. 3. PILLAR OR WHIP CRANE.

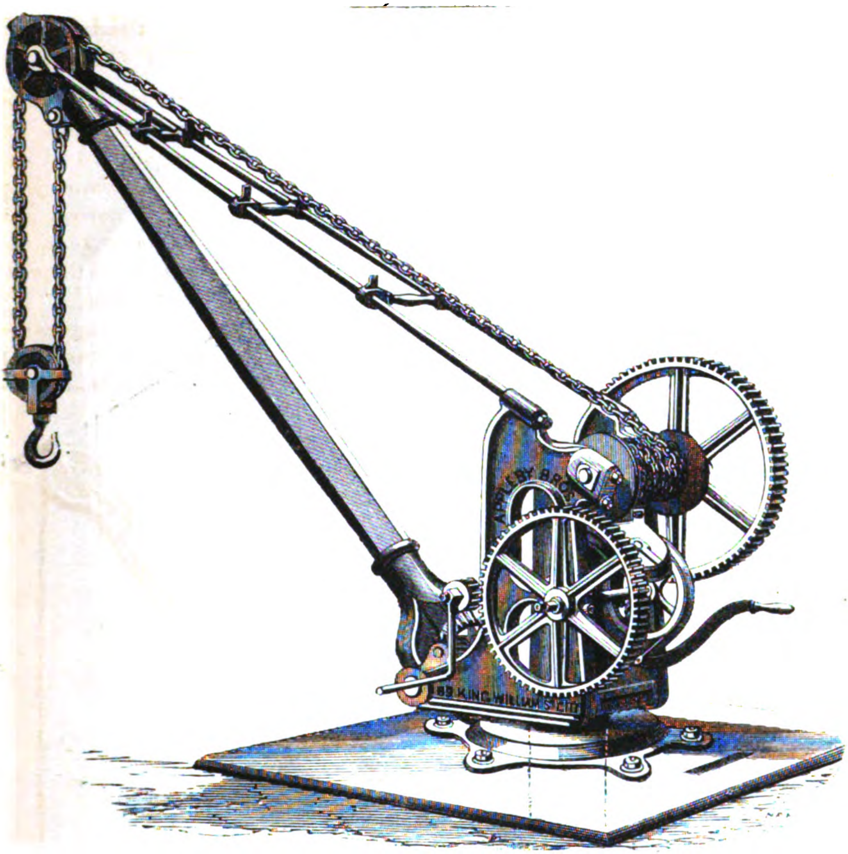
THIS Crane differs from that illustrated at page 53, in being attached at the top to a tie-beam or joist, but in other respects it is generally similar to it, and when made of iron the prices are about the same.

Cranes of similar construction, but made of wood, and to lift 1 ton, are worth about £28.





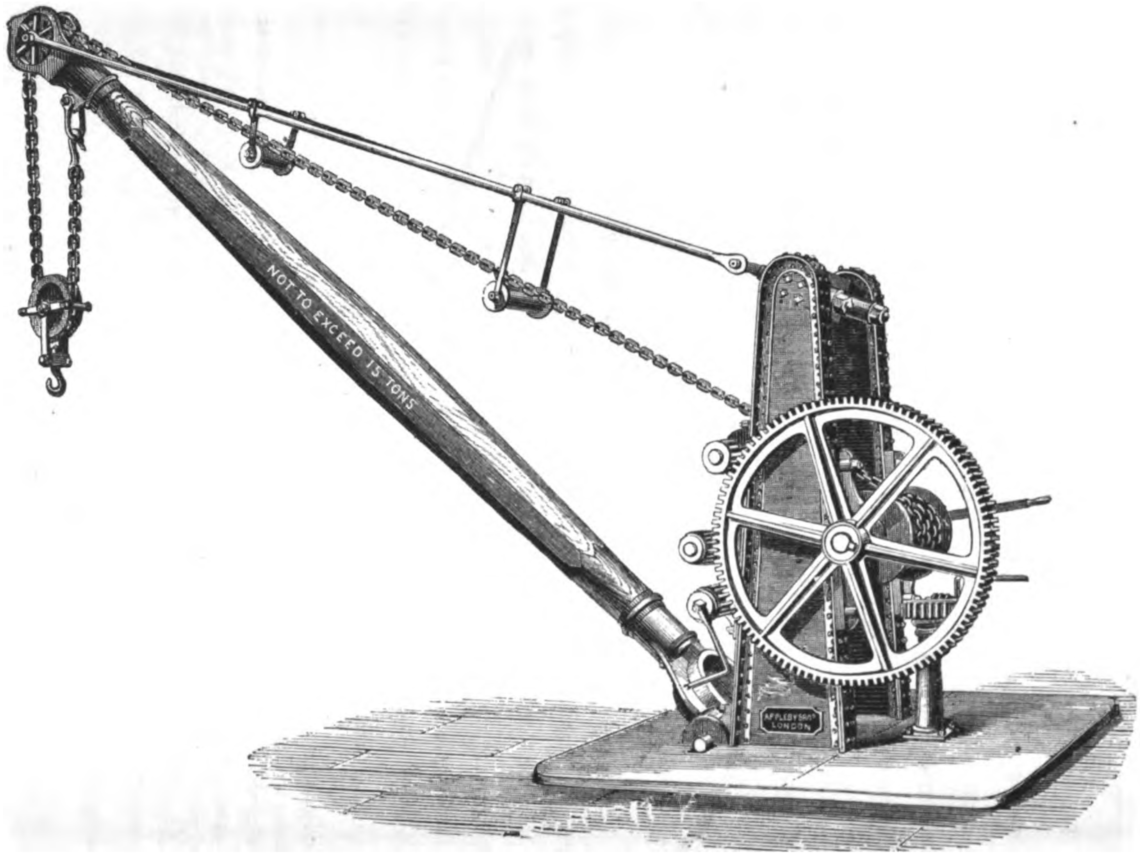
No. 4. HAND WHARF CRANE.



No. 5. HAND WHARF CRANE.

The smaller sizes of Cranes up to 3 tons (No. 4, see page 54) are usually made without radiating motions, but the larger sizes to lift 5 tons and upwards (No. 5) have radiating motions and a turned conical roller path on the base plate, which is bolted to the necessary foundations. The crane post is of ample section, and is secured in an iron toe step at bottom. Each size is fitted with single and double purchase motions and a powerful strap break and lever, and two winch handles. The chain is charged as at page 66, according to the length required.

No. 4.	To lift 1 Ton	Price £45	0	0
	„ 2 Tons	„ 60	0	0
	„ 3 Tons	„ 80	0	0
No. 5.	„ 5 Tons	„ 120	0	0
	„ 10 Tons	„ 250	0	0
	„ 15 Tons	„ 390	0	0
	„ 20 Tons	„ 450	0	0



(No. 6.) FIFTEEN TON WROUGHT IRON HAND WHARF CRANE. (See p. 57.)

(No. 6.) FIFTEEN TON "GOVERNMENT PATTERN" WROUGHT IRON HAND WHARF CRANE.

The conditions under which this Crane was designed were :—

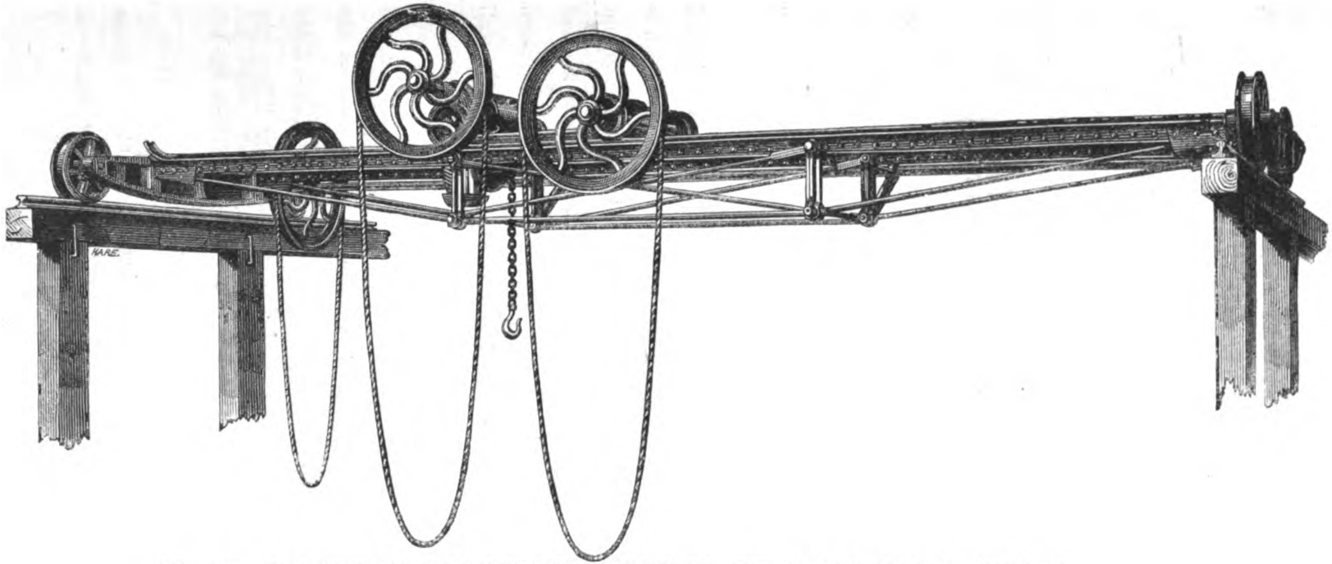
That for facility of transport, landing, and erection, no piece should weigh more than 25 cwt.; that it should be easily fixed in soft ground; and (in the instance under consideration) that it should be made of a material not liable to fracture in extreme cold.

To fulfil these conditions, the authors designed and constructed the Crane illustrated, for the War Department of Her Majesty's Government, for landing guns and heavy stores, and it differs materially from the wharf cranes usually made (see p. 55), which revolve on a massive cast or wrought iron crane post, keyed in a foundation plate.

In this case the Crane sides are made of a pair of wrought iron girders, braced together at intervals, and connected at the bottom by a distance piece, in which is a steel toe working in a steel cup or shoe; the girders thus form the post, and at the same time serve to carry the whole of the lifting gear. There is another distance piece at the ground line, fitted with three strong friction rollers placed horizontally and working against a turned ring, which forms the top of the well hereafter described.

The well is made of cast iron rings bolted together internally, and filled round the outside with concrete, and faced with stone at the top. The radius of the Crane is 20 feet, and being required for light as well as heavy loads, it is fitted with single, double, and treble purchase gear, and a snatch block for lifting the heaviest loads, and the radiating gear has a single and double purchase for use according to the work in hand.

Many other Cranes generally similar in design have been made, and the prices are somewhat, but not materially, higher than those of Wharf Cranes of the usual type (see p. 55).



(No. 7.) OVERHEAD TRAVELLER WORKED BY HAND FROM BELOW.

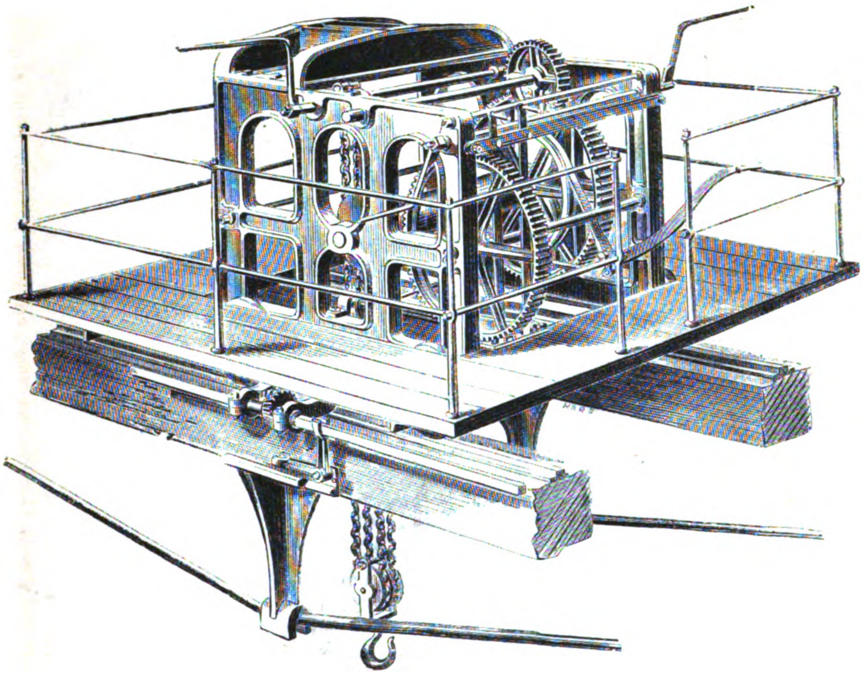
The Traveller illustrated is usefully employed in situations where the head-room is limited, or where lifts are only occasionally required, as well as in works where noxious gases are generated, and the atmosphere near the roof is unwholesome.

The end cradles are of cast iron, and carry the longitudinal girders, which are formed of two strong angle-irons rivetted back to back, with a bridge rail rivetted to the upper members: these are trussed with cast-iron struts and round wrought-iron tension bars. All the motions are worked from below by hauling ropes or chains, and the lifting gear is given by a worm and wheel, insuring great safety, and obviating the necessity for a break, and the load will remain in the position in which it may be left.

		20 feet span.	30 feet span.
To lift 2 Tons	price	£60 0s. 0d.	£65 0s. 0d.
" 3 Tons	"	70 0 0	80 0 0
" 4 Tons	"	90 0 0	100 0 0
" 5 Tons	"	120 0 0	140 0 0

As the height varies considerably, the prices quoted do not usually include ropes or chains.

Travellers of similar construction, but the lifting motion given by spur gear instead of worm and wheel, are about the same prices as quoted above.



(No. 8.) OVERHEAD TRAVELLING CRANE FOR HAND POWER.

The Crab consists of a strong iron framing and sides fitted with gun metal bearings throughout, single and double purchase lifting gear, foot brake and pawl for holding the load suspended. The whole is mounted upon four travelling wheels, and is surrounded by a timber platform with wrought-iron railing. All the motions *are obtained from the Crab,* and the longitudinal and transverse travelling motions can both be worked at the same time if required.

The travelling gantry is usually formed of trussed timber beams as shown in the above engraving, but for hot climates wrought-iron girders are frequently used.

The timber beams have a cast-iron shoe on each end to take the ends of the tension bars, which are thickened, so that the bottom of the thread has the same diameter as the tension bar. The screws are cut in the lathe, and the nuts chased and faced.

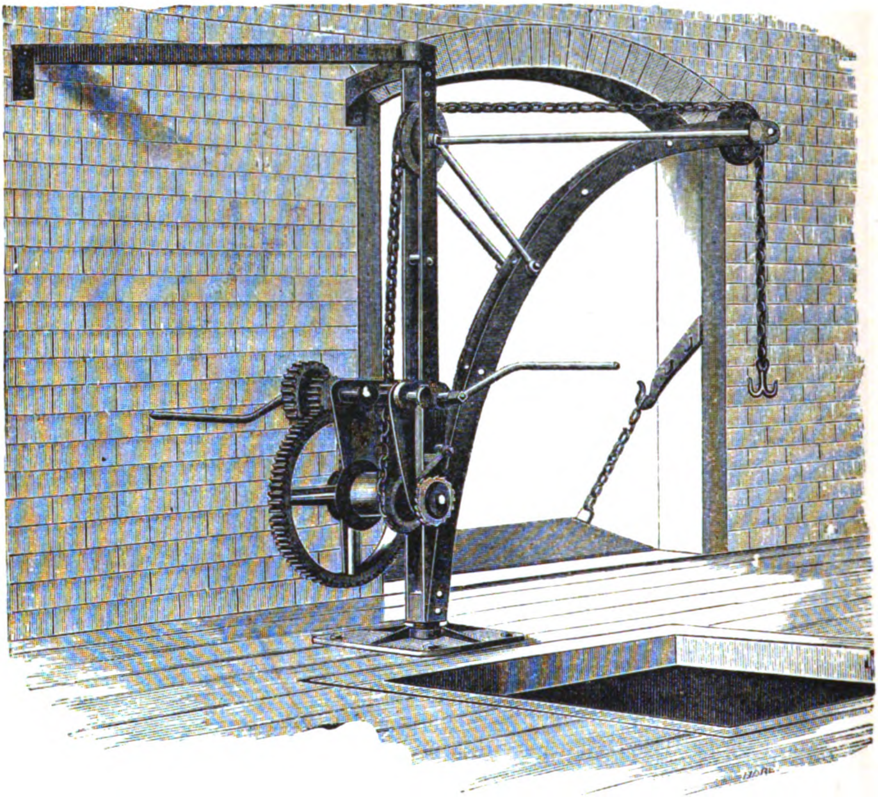
The gantry travelling wheels are carried in wrought-iron box girders (as shown in No. 2 Steam Traveller, p. 21), the shoes and the part of the box girders on which they rest being both planed to a true surface.

The longitudinal travelling motion is given from a shaft with tumbler bearings running from end to end of the gantry.

In some cases timber is used instead of the Box Girders named above.

The Traveller is complete with everything necessary for working (excepting chains) when mounted upon the longitudinal rails, but the *ironwork only* will be supplied if desired.

The engraving is taken from a 10-ton Traveller of fifty feet span, as made for Her Majesty's Government, but larger or smaller Travellers are supplied, and all applications for price should be accompanied by particulars of the span required and the load to be lifted.



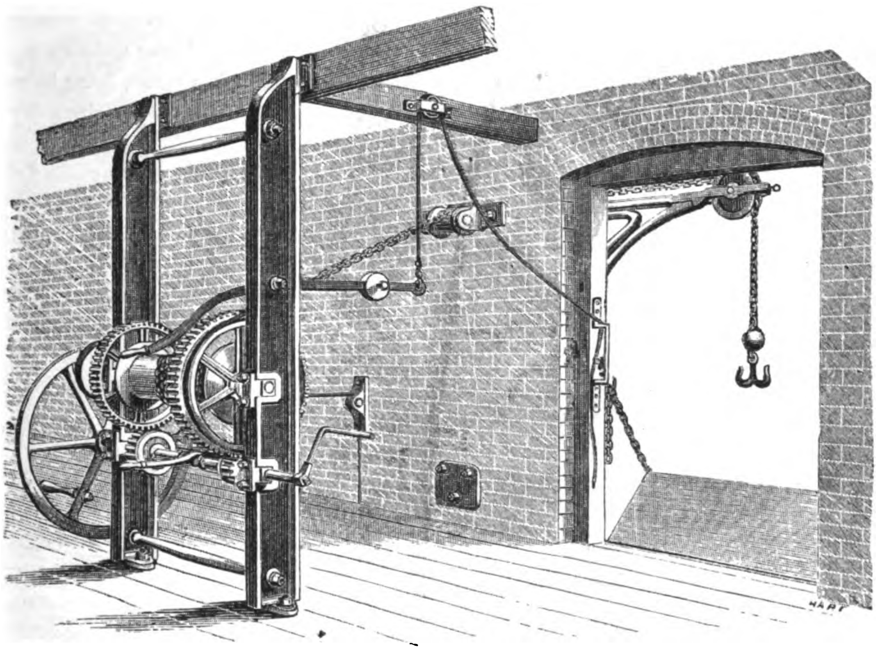
No. 70.) WROUGHT IRON JIB CRANE WITH GEAR ATTACHED.

WHEN used for lifting through traps in granaries or on flat-roofed buildings the Crane is usually stayed back in the same way as a Derrick Crane (see p. 52).

It is constructed entirely of iron, and is fitted with single and double purchase lifting gear, ratchet wheel and pawl for holding the load, and a strap break can be supplied if required. The top and bottom toe pieces are usually made for bolting to timbers in the way shown, but many circumstances will occur where a different arrangement is desirable.

The prices of these Cranes vary with the weight to be lifted, the radius required, the height of the back standard, &c. so that it is difficult to give any scale of prices which may be taken as generally applicable, but an idea of the value may be obtained from the following:

A Crane to lift 1 Ton at 7 feet radius and 7 feet high from the ground line to the underside of the Jib is worth, complete, about £20.



(No. 71.) HAND CRANE FOR WAREHOUSES, DOCKS, BREWERIES, FACTORIES, &c.

The sides are of Iron, fitted with gun metal bearings, and are bolted at top and bottom to the floors; there is a quick speed for light weights, and a double purchase or slow speed for heavy weights, each motion being under the control of the men working the Crane; there is also a powerful Break apparatus which can be applied at the Crane, or by the men receiving or discharging loads at any floor.

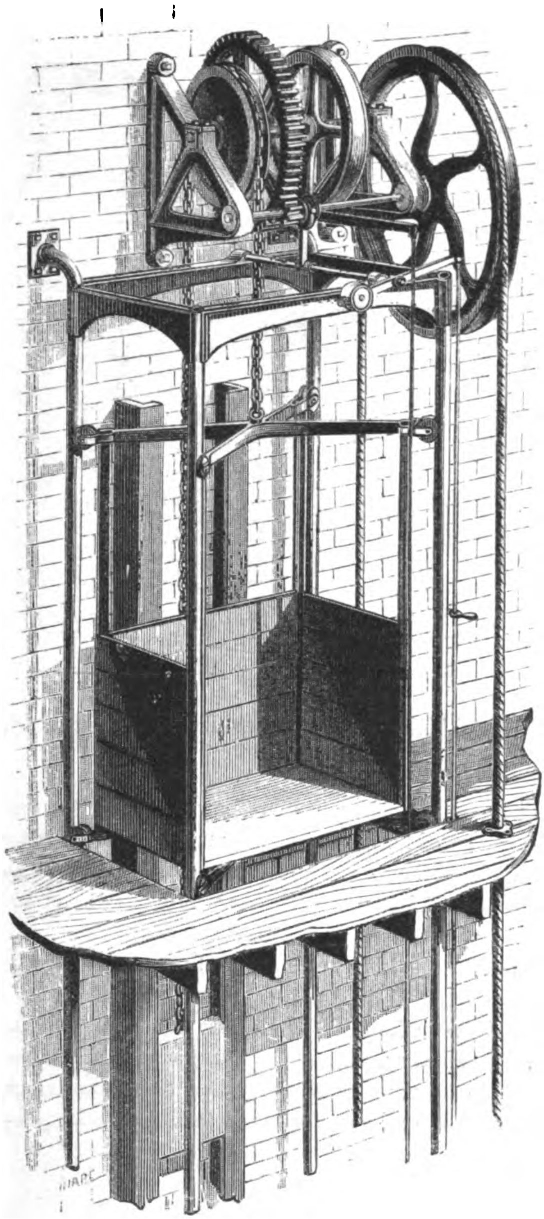
In many instances the Crane is fitted with an apparatus for running up the empty chain after the load is taken off. This arrangement greatly increases the speed of working and lessens the labour in hoisting, but where much work has to be done, or where great dispatch is necessary, the steam arrangements illustrated and described at pp. 40–43, will be found more economical than any arrangement, however ingenious for reducing the cost, or increasing the speed, of working by hand.*

Approximate cost of Hand Warehouse Cranes:—

Double-purchase Crane to lift about 20 cwt.	£25	0	0
Chain for 40 feet Lift, radius piece, Hook, and Balance Ball .	7	10	0
Warehouse Jibs, see p. 63	14	0	0

For prices of ordinary lifting Crabs, see pp. 63, 64, &c.

* See article on the use of Steam Cranes, pp. 2, 3.



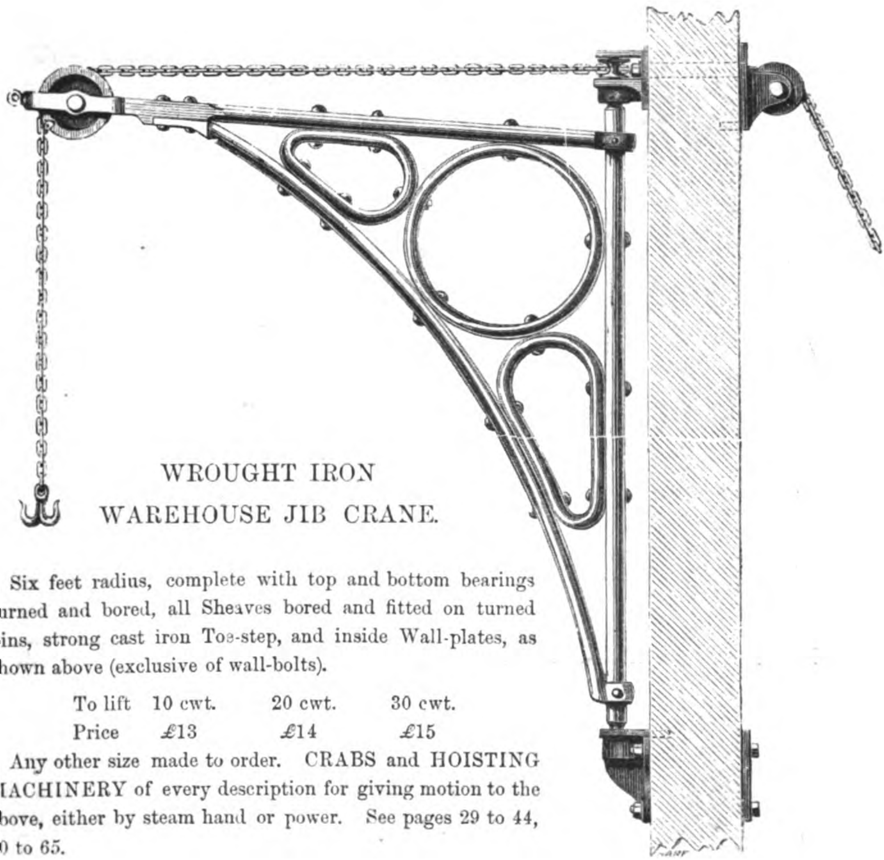
HAND POWER LIFT FOR WAREHOUSES, FACTORIES, OR PUBLIC BUILDINGS.

The Lift as engraved, represents a very convenient arrangement for placing against a flat wall or in a corner, being independent and self-contained.

The wrought iron columns at each corner serve as guides for the Cage, and as supports for the lifting gear when it is erected as shown, but it is frequently more convenient to carry the columns to the floor or roof above, and in that case the machinery can be out of sight.

The Cage, with turned gunmetal guide rollers at each corner, top and bottom, is made of any desired form, and being counterbalanced by a weight running in guides immediately behind (or at a distance from the Cage as may be convenient), the power required is only that necessary for lifting the net load. Each lift is fitted with a powerful break, and a light rope to work it is carried in guides the whole length of the hauling rope; the larger sizes have single and double purchase lifting gear; the hauling rope remains stationary whilst the cage is lowered by the break. If fitted with Hensman's Patent Safety Break, the *break is always on* when not purposely released.

These Lifts have been erected in Factories, Warehouses, Hospitals, Banks, Hotels, &c. and may be seen at work both by hand and steam power, and with the lifting gear above or below, as circumstances have required. (See also p. 43.)

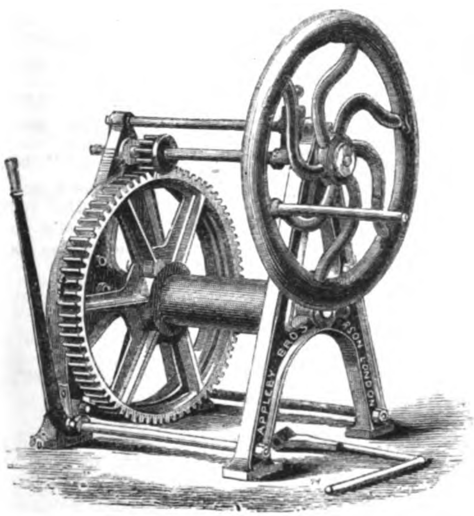


WROUGHT IRON
WAREHOUSE JIB CRANE.

Six feet radius, complete with top and bottom bearings turned and bored, all Sheaves bored and fitted on turned pins, strong cast iron Toe-step, and inside Wall-plates, as shown above (exclusive of wall-bolts).

To lift	10 cwt.	20 cwt.	30 cwt.
Price	£13	£14	£15

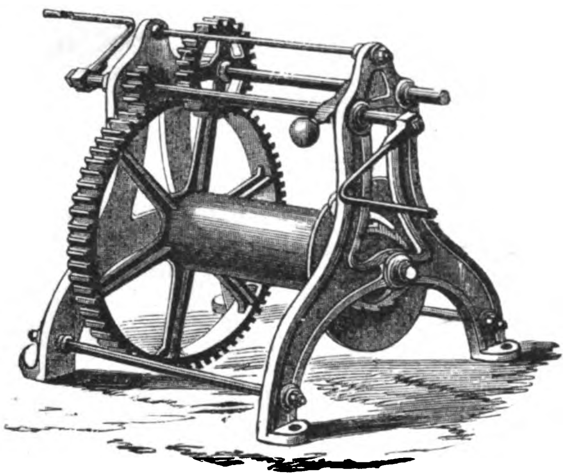
Any other size made to order. CRABS and HOISTING MACHINERY of every description for giving motion to the above, either by steam hand or power. See pages 29 to 44, 60 to 65.



No. 1. SINGLE PURCHASE CRAB WINCH.

	£	s.	d.
Strong Pattern (as shown, except with 2 handles, no fly-wheel or strap-break) to lift 1 ton *direct from the barrel*	4	15	0
Heavy fly-wheel, extra . .	1	10	0
Light Pattern, to lift 15 cwt. *direct from the barrel* . .	3	15	0
Ditto, 30 cwt. ditto . .	5	0	0

Strap Breaks, 20*s.* and 30*s.* extra respectively.

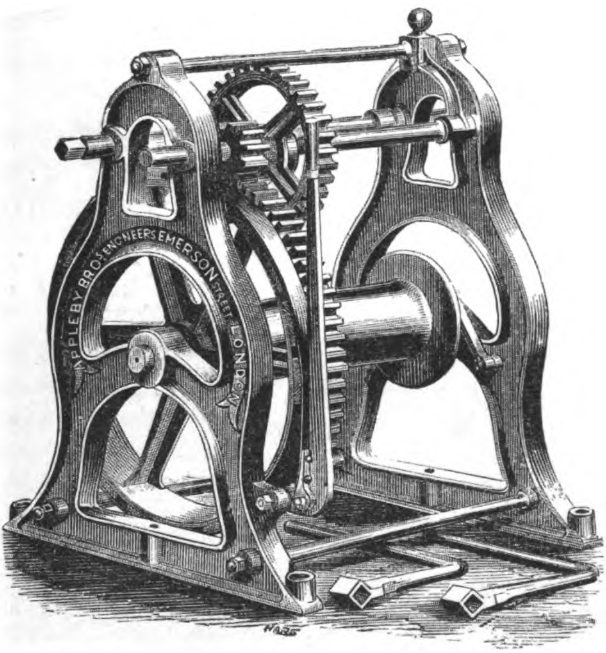


No. 2. LIGHT DOUBLE PURCHASE CRAB, without Strap Break.

	£	s.	d.
Complete with handles, to lift 2 tons, price	6	10	0
Ditto, to lift 3 tons, price	8	0	0

If with strap break and lever, respectively 20s. and 30s. extra.

No. 3. "GOVERNMENT PATTERN" STRONG CRAB, OR WINCH.



THE shafts are turned throughout and the bearings are accurately bored; the subjoined prices include handles, strap break lined with hard wood, break lever, pawl wheel and pawl for holding the load suspended.

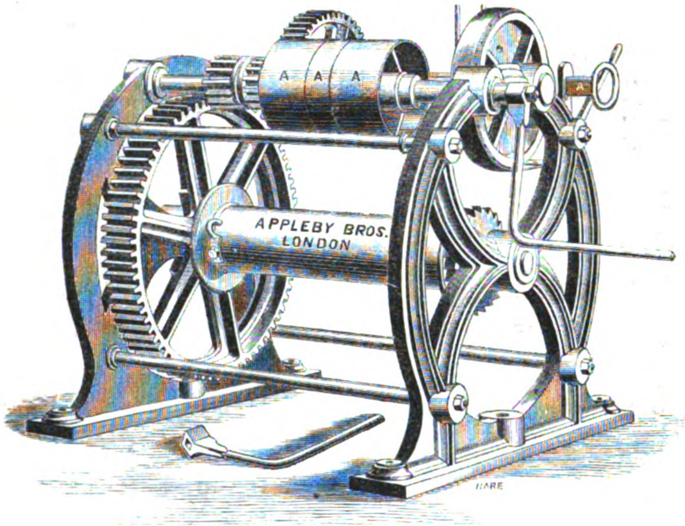
The proportions throughout are ample for working the load specified.

	£	s.	d.
To lift 3 tons, price	10	0	0
Ditto, 5 tons, ,,	13	10	0
Ditto, 10 tons, ,,	20	0	0

With capstan ends or "fleeting barrels" 10s. to 15s extra for each end.

With gun-metal bearings for the first and second motion shaft, 25s. to 35s. extra.

All these Crabs will lift greater weights with Pulley Blocks, in proportion to the number of sheaves used. (See table of powers of Pulley Blocks at page 68.)



(No. 4.) "GOVERNMENT PATTERN" STRONG CRAB OR WINCH.

These Winches have been designed by the Authors for use in Arsenals, Dock-yards &c. and they are adopted by her Majesty's Government for the heaviest class of work.

They are proportioned to lift the load specified, with a total expenditure of 40 lbs. on the handles, and the handle shaft is about 3 ft. 6 in. from the ground line.

The shafts are all turned, and the bearings are accurately bored out in place; the main wheel is bored and slotted, and is keyed on the barrel, upon which is also a wrought-iron pawl wheel and pawl; the break wheel is on the second motion shaft; the break strap is lined with hard wood and fitted with a screw for taking up wear, and a suitable break lever.—

To lift 15 tons. . . . . Price £37 0*s.* 0*d.*

If with heavy gun-metal bushes to all bearings „ £5 10*s.* 0*d.* extra.

These Winches have also been used with blocks for lifting weights up to 40 tons by steam power; for this purpose they have a set of pulleys AAA and a forked lever for throwing the strap on to the loose pulley, the lifting and lowering motions being given by a cross and a straight strap without stopping or reversing the engines. This arrangement is inexpensive, but as it varies, the cost can only be given approximately.

The cost of this Winch, fitted with one fast and two loose pulleys and forked lever as described, will be about £42 0*s.* 0*d.*

If with gun-metal bushes to all bearings £5 10*s.* extra.

IRON CHAIN, SHORT-LINK CABLE.

Size of Iron. Inches	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1⅛
Average weight per yard . in lbs.	1⅛	2	3	4½	5¾	8	9¾	12½	14½	17½	24	31½	39
*SHORT-LINK CHAIN, ordinary Cable quality . . . . price per cwt.	72/0	49/0	37/0	30/4	26/0	23/0	22/6	21/0	19/8	18/9	18/0	17/2	16/8
*STUD CHAIN, (quality as above), less	—	—	—	—	—	—	9*d.*	9*d.*	9*d.*	9*d.*	9*d.*	9*d.*	9*d.*
Proof Strain of Crane Chains. Tons (See Diagram and Tables).	—	—	1⅛	1½	2¼	3	3¾	4⅝	5⅝	6¾	9⅛	12	15¼
Best *proved* CRANE CHAIN . per cwt.	76/6	58/0	41/6	35/0	30/8	27/8	27/4	25/8	24/8	24/0	22/6	22/0	21/6
Best *proved* CRANE CHAIN . per yard	1/0	1/1	1/1½	1/4½	1/7½	2/1	2/4	2/10	3/2	3/9	4/10	6/3	7/6

Best proved UNIFORM LINK CRANE CHAIN, at same prices, per yard.

Best SHORT LINK COIL CHAIN, see page 383.

It is safe to calculate on only half the proof strain; thus, to lift 1½ ton, use ⅜ chain at the least.

* Commoner quality of Chains at lower prices if required.

BEST WHITE HEMP ROPE FOR "BLOCKS AND FALLS."

Circumference of Rope, Inches	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
Proof Strain, ... Tons	—	—	—	—	¾	—	—	1½	—	—	2½
Approximate Price, per Yard	2¾*d*	3¾	4	4½	6	7½	9	10½	1/0	1/1½	1/4

Circumference of Rope, Inches	4¼	4½	4¾	5	5½	6	6½	7	7½	8
Proof Strain, ... Tons	—	—	3½	—	—	—	—	—	—	—
Approximate Price, per Yard	1/6	1/9	1/11	2/2	2/7	3/0	3/6	4/0	4/7	5/3

Larger sizes at 9*d.* per lb. or special quotations, *for quantities.* For comparative weight and strength and strains of Ropes and Chain Cables, see Tables. The prices will vary according to the market value of the material.

LENOX' PATENT MALLEABLE IRON BLOCKS FOR RIGGING,

Fitted with any kind of Mounting; Single, Double, or Treble, from 4 in. and under 8 in. at 1/6 per lb., 8 in. and under 13 in. 1/4 per lb. Larger, 1/5 per lb.

ROPE SCORE BLOCKS, all sizes, 1/2 per lb. SHEAVES, under 13 in. diameter, 1/0 per lb.

SNATCH BLOCKS, 6, 8, and 10 in. at 1/10 per lb. 12 and 14 in. 1/6 per lb. including Galvanizing.

BEST LONDON-MADE PULLEY-BLOCKS.

With Pins and Sheaves turned and bored, and best Scrap-iron hooks.

Diameter of Sheave.	Diameter of Chain.	Girth of Rope.	Price. 1 Sheave.	Price. 2 Sheaves.	Price. 3 Sheaves.	Price. 4 Sheaves.	Snatch Blocks to suit.
	In.	In.					
3		2¼	11/0	14/6	18/6	25/0	20/6
4		2½	13/0	16/6	25/0	31/0	24/0
5	¼	3	19/6	26/6	37/6	50/0	31/0
6	⅜	3½	23/0	40/0	67/0	84/0	37/0
7	½	5	29/6	53/6	83/6	107/0	41/0
8	⅝	6	40/0	73/6	100/0	126/0	59/0
9	¾	7	60/0	86/6	127/0	180/0	72/0
10	¾	8	80/0	132/6	187/0	213/0	100/0

Gun-metal Sheaves extra. It should be stated, in giving orders, whether for *ropes* or for *chains*.

Extra Strong and wide Pulley Blocks of the best construction and material, are made for lifting heavy Guns or other weights, and for special purposes. The Hooks, Pins, and Ironwork being sufficiently strong to lift the weights specified.

	1 sheave.	2 sheaves.	3 sheaves.
9 inches diam. to lift 15 tons with ⅝ in. chain,	£5 0s.	£7 10s.	£9 10s.
12 ,, ,, 20 ,, ¾ ,,	9 0	11 0	13 10
12 ,, ,, 20 ,, 1 ,,	10 0	12 10	16 0
18 ,, ,, 30 ,, 1 ,,	11 10	15 10	21 0

WOOD PULLEY BLOCKS OR "TACKLES."

Diameter of Sheave.	Girth of Rope	Price. 1 Sheave.	Price. 2 Sheaves.	Price. 3 Sheaves.
In.	In.			
2	1¼	1/4	2/8	4/0
3	1½	1/4	2/8	4/0
4	1¾	1/4	2/8	4/0
5	2	1/4	2/8	4/0
6	2¼	1/7	3/0	4/6
7	2½	1/8	3/4	5/6
8	2¾	2/0	3/8	6/6
9	3	2/0	4/0	5/4

Larger sizes are made if required.

If Bushed with Brass the prices are double the above list.

GIN BLOCKS,

Whip Gins, Rubbish Pulleys, or Monkey Wheels, with frames and hooks complete.

GIN BLOCK.

Diam. of Pulley	3½	4¾	6	7	8	9	10 inches.
Price, each . .	5/9	6/3	7/0	7/9	8/6	9/3	10/0
Diam. of Pulley	11	12	14	16	18	20	22 inches.
Price, each . .	11/0	12/0	13/0	16/6	21/0	24/0	27/6

Tangye's Table to calculate the sizes and Lifting Powers of Pulley Blocks.

Diam. × Width	2½ × ⅜	3½ × ½	4 × ⅝	4¾ × ¾	5 × ⅞	6 × 1	7 × 1¼	8 × 1½	9 × 1¾	10 × 2	11 × 2¼	12½ × 2½	14 × 2¾	15 × 3	16 in. × 3¼ in.
Each Sheave to lift.	1	3	5	7	10	12	18	27	35	48	60	75	90	105	120 cwt.

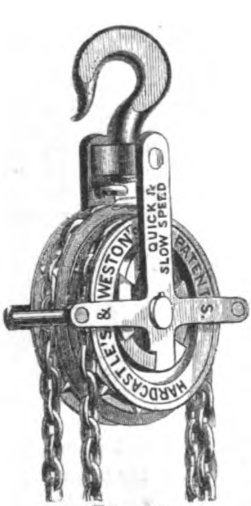
To ascertain the size and number of Sheaves required to lift a given weight :—

Divide the weight to be lifted, by any weight in the above table ; the result will give the number of Sheaves, and sizes of Blocks required.

For instance—If 60 cwt. is to be lifted, either of the following combinations will be suitable—

A pair of 3 and 3 Sheave, ⅞ in., at 10 cwt. per Sheave } equal 60 cwt.
Or, ,, 2 and 3 ,, 1 in., ,, 12 cwt. ,,

NOTE.—The powers given above, are approximately correct, but in ordering, it is always advisable to leave a sufficient margin.



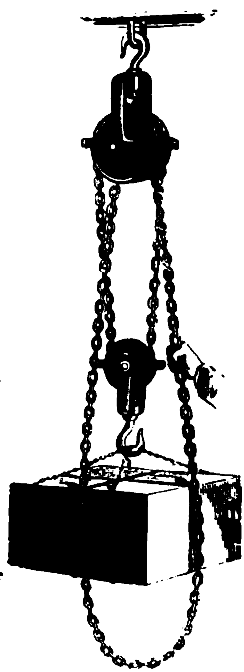
(FIG. 1.)

(FIG. 1.) WESTON AND HARDCASTLE'S

QUICK ACTION PATENT PULLEY BLOCKS.

By this improvement the important facility of raising and lowering the bottom block QUICKLY, when not loaded, is united with the differential action of Weston's Blocks when loaded.

The length of chain should be four times the height of "Lift."

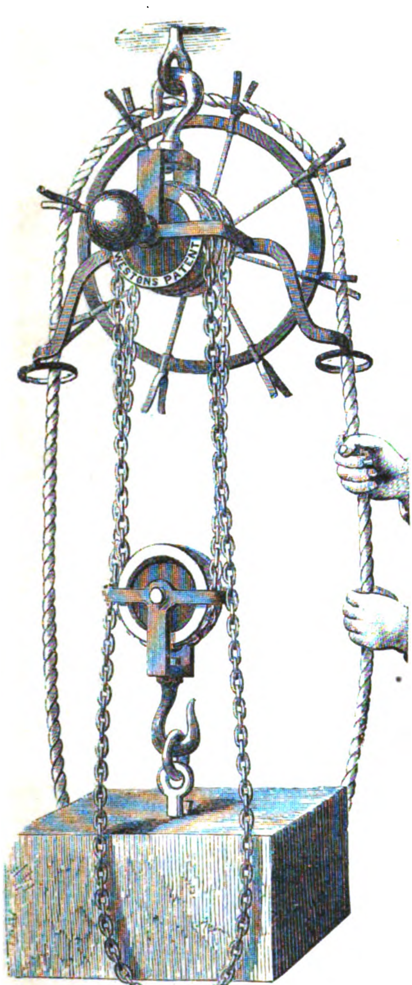


(Fig. 2.)

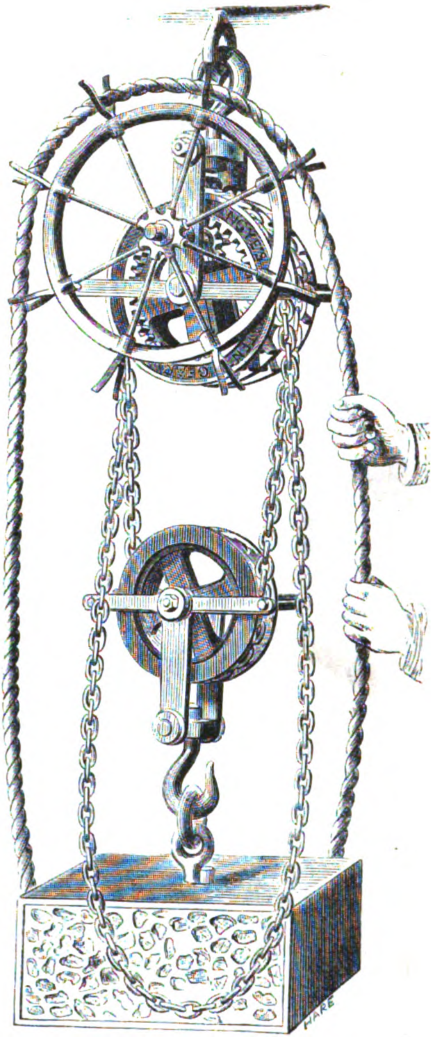
WESTON'S PATENT DIFFERENTIAL PULLEY BLOCKS.

THE peculiar feature of these Pulleys consist in their being more powerful than ordinary pulley blocks, and they possess the valuable property of not running down whilst the load is suspended, even if the chain is suddenly let go when either hoisting or lowering.

In ordering these blocks of either kind, it is necessary to specify the *height of lift*, or state the length of chain required. When worked from above, with ratchet or spocket wheel, the chain will be about *three times* the height of lift. When worked from below, by pulling the chain, about *four times* the height of lift is required.



(Fig. 3.)

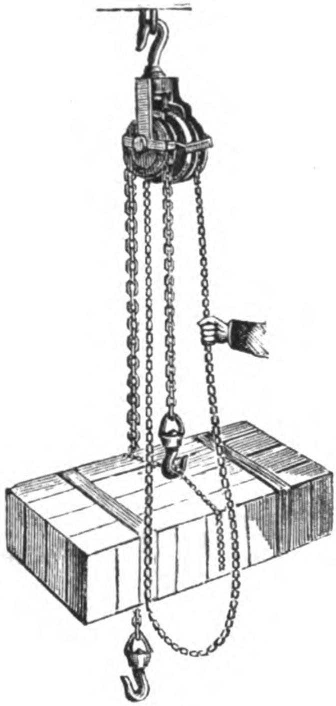


(Fig. 4.)

Tested to	5 Cwt.	10 Cwt.	12 Cwt.	1 Ton.	1½ Ton.	2 Tons.	3 Tons.	4 Tons.	5 Tons.	6 Tons.	8 Tons.	10 Tons.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Fig. 1. Weston and Hardcastle's, per set	45 0	45 0	—	60 0	75 0	90 0						
Fig. 2. Weston's to work from below, per set	20 0	30 0	30 0	40 0	55 0	65 0						
Fig. 3. Ditto, with Spocket wheel ...	—	—	—	—	—	80 0	115 0	140 0				
Fig. 4. Ditto, with Tangye's patent gear	—	—	—	—	—	—	—	140 0	200 0	240 0	320 0	400 0
Bright chain, per foot	6	6	7	9	10	10	1 1	1 3	1 6	2 4	3 0	5 6
Rope for spocket wheel per foot ...	—	—	—	—	—	5	5	7	7	9	1 0	1 0

Ratchet Levers from 13*s.* in the small size, to 37*s.* 6*d.* each, extra.

PATENT EPICYCLOIDAL PULLEY BLOCKS.



No. 1.

PULLEY BLOCK. To Pull from Below.

No. 3.

PULLEY BLOCK with SPOCKET WHEEL. When the Spocket Whe is used two Men can lift the weig specified.

Tested to Tons.		¼	½	1	1½	2	3	4	5	6	8
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
No. 1.—Block to pull from below	each	20 0	30 0	40 0	55 0	65 0	—	—	—	—	—
No. 3. — Ditto, with spocket wheel, and has a small pulley for light weights the hand chain being transfrble	,,	—	—	—	—	85 0	115 0	140 0	—	—	—
No. 4. — Ditto, with spocket wheel and compound Gear, and has a small pulley for light weights, the hand chain being transferable.	,,	—	—	—	—	—	—	—	200 0	240 0	320 0
Chains, including hand chain, price *per foot of lift*		2 0	2 0	3 0	3 4	3 4	4 4	5 5	6 0	9 4	12 0

Note.—The Chains are charged according to the HEIGHT of LIFT, and not according to the length of chain,—for instance: a set of Chains for a 2 Ton Block, to lift 10 feet, is, at 3/4 per foot of Lift, £1 13*s.* 4*d.*

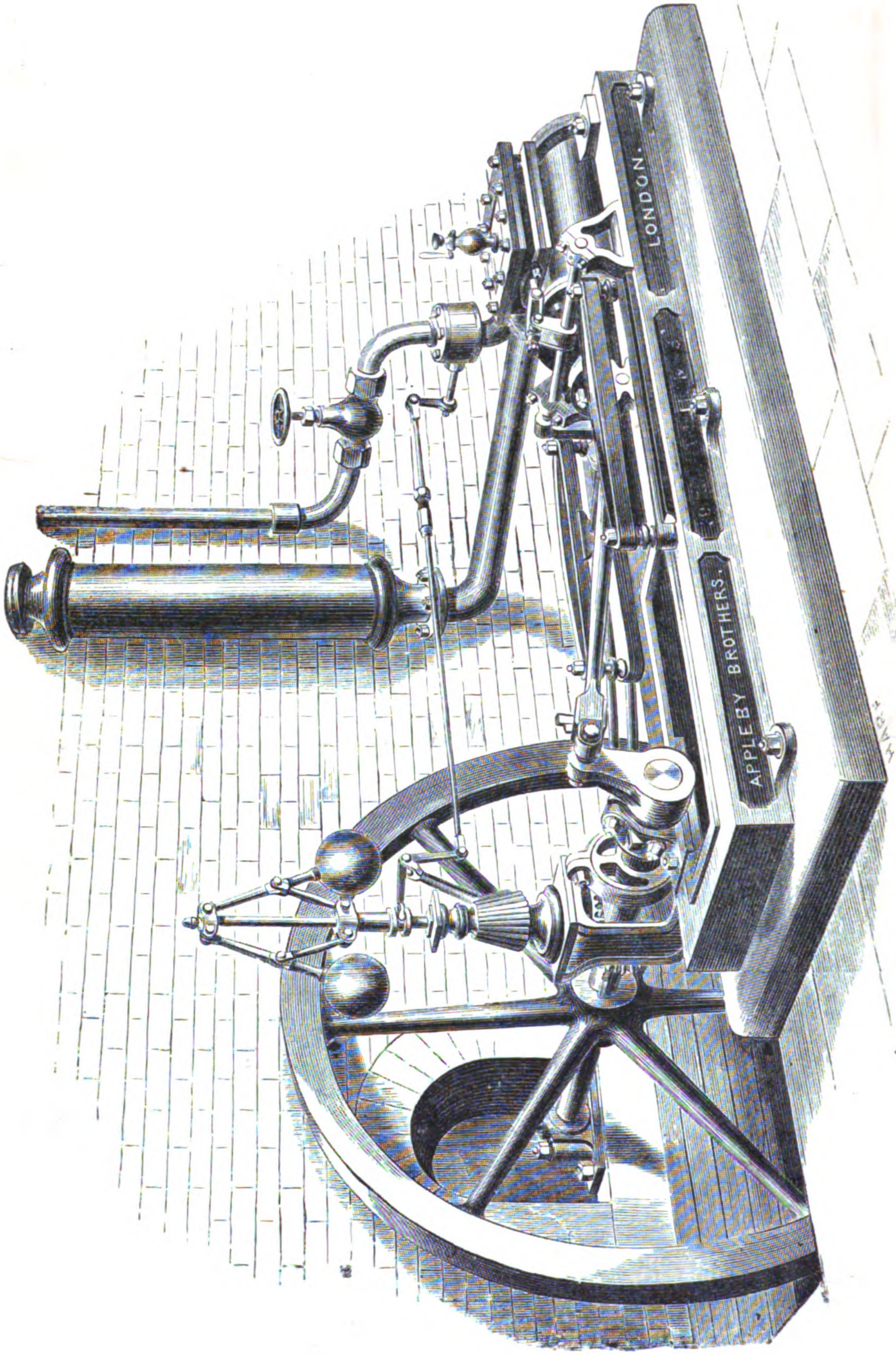
The Hand Chain is suitable for both the small wheel and the spocket wheel.

In ordering these blocks it is necessary to specify the PATTERN, WEIGHT, and HEIGHT of Lift.

ENGINES AND BOILERS,

TURBINES, WINDMILLS,

DREDGERS AND SCREW PROPELLERS.



FIXED HORIZONTAL HIGH-PRESSURE STEAM ENGINE.

FIXED HORIZONTAL HIGH-PRESSURE STEAM-ENGINE, WITH CYLINDRICAL CORNISH BOILER.

The principle of this Engine is Direct Action, the working parts are easy of access, and are secured to a strong metal Foundation-plate, provided with bolts and nuts for fastening to stone, or brickwork, or wood-framing.

The Cylinder has turned flanges, bright polished cover, metallic piston with steel segment, brass tongues, and steel springs, piston-rod of best cast-steel, bright cross-head, cross-shaft with blocks lined with gun-metal, two sets of slide-bars planed and scraped, crank-shaft of best hammered scrap iron, working in gun-metal bearings, bright turned connecting-rod with gun-metal head, &c., polished gun-metal eccentric strap with bright rod fitted to valve motion, force-pump with gun-metal clacks and seatings, air vessel and covers, easily accessible, bright governors and lever, heavy fly-wheel accurately balanced and turned on the edge for a strap if necessary. The steam is supplied from a Cylindrical Cornish Boiler, of ample size and strength, with one tube (or in the larger sizes *two* tubes) through the whole length, made of best materials and tested to a high pressure, and fitted with patent steam-gauge, water-gauge and cock, safety-valve, blow-off cock, furnace-door, fire-bars, bearer and dead-plate, and every necessary for the safe, efficient, and economical working of the whole. The annexed prices include all complete to the end of fly-wheel shaft, but exclusive of pipes to connect Engine and Boiler (which will vary according to the distance apart) :—

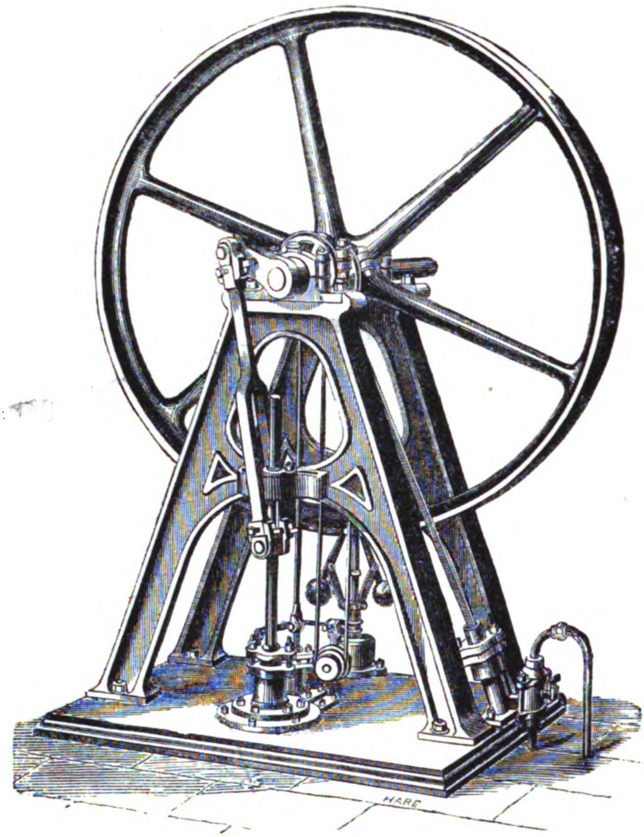
Horse power of Engine	4 H. P.	6 H. P.	8 H. P.	10 H. P.	12 H. P.	16 H. P.	20 H. P.	25 H. P.	30 H. P.	40 H. P.	50 H. P.
Diameter of Cylinder . in.	6½	8	9	11	12	14	16				
Length of Stroke . . in.	13	20	20	24	24	30	30				
Price of Engine only	£52	£76	£96	£120	£140	£190	£220	£290	£340	£455	£565
Price of Engine and Cornish Boiler, with fittings complete, as described	£113	£145	£186	£220	£262	£340	£420	£530	£620	£760	£915
Price of Packing for Export, at 15*s.* per H. P. (£ *s.* *d.*)	3 0 0	4 10 0	6 0 0	7 10 0	9 0 0	12 0 0	15 0 0	18 15 0	22 10 0	30 0 0	37 10 0
Extra, if fitted with Condenser (For Patent "Siphon Condenser" see page 335.)	18 0 0	25 10 0	30 0 0	36 0 0	41 0 0	50 0 0	62 0 0	64 0 0	70 0 0	80 0 0	90 0 0
Average Consumption of Common Coal per hour at 45 lb. pressure	32 lbs.	42 lbs.	56 lbs.	70 lbs.	84 lbs.	112 lbs.	136 lbs.	172 lbs.	205 lbs.	275 lbs.	340 lbs.
Average Evaporation of Water per hour at 45 lb. pressure	22 Galls.	30 Galls.	40 Galls.	50 Galls.	60 Galls.	80 Galls.	100 Galls.	125 Galls.	150 Galls.	200 Galls.	250 Galls.
Ditto Consumption of Water when Condenser is added	250 ,,	380 ,,	500 ,,	630 ,,	750 ,,	1,000 ,,	1,300 ,,	1,700 ,,	2,000 ,,	2,500 ,,	3,000 ,,
Approximate Weight of Engine, packed	18 cwt.	45 cwt.	48 cwt.	50 cwt.	70 cwt.	100 cwt.	115 cwt.	130 cwt.	160 cwt.		
Ditto ditto of Boiler and Fittings	26 cwt.	45 cwt.	50 cwt.	57 cwt.	70 cwt.	115 cwt.	120 cwt.	140 cwt.	230 cwt.		
Approximate Measurement of Engine when packed, in cubic feet	40 ft.	83 ft.	90 ft.	95 ft.	145 ft.	215 ft.	245 ft.	260 ft.	280 cwt.		

For Exportation it is advisable to send with each Engine a set of Extras as follows : 2 pairs of main-shaft brasses, 1 set of brasses for large end of connecting-rod, 1 set of piston-rings and springs, 1 set of eccentric brasses, 1 set of furnace-bars for boiler, and 6 gauge-glasses and rings.

Link-motion Reversing Gear can be attached at an extra charge.

Horizontal Engines from 10 horse-power with 2 Cylinders, if required.

The improved Water Heater (as shown in the engraving) is highly recommended, price extra from £10 to £20. If with expansion valve, extra from £10 to £25. For Engines of more than 30 horse-power, two boilers are recommended.



FIXED VERTICAL HIGH-PRESSURE STEAM-ENGINE,

WITH CYLINDRICAL CORNISH BOILER.

The general specification of this Engine is similar to the Horizontal Engine on preceding page. The Vertical Standards, and all the working parts of the Engine, are fixed upon a strong metal base-plate, so that the whole may be easily erected upon a stout brick or timber foundation. The end of the fly-wheel shaft is usually (but not necessarily) carried in a wall-box. Engines of this construction are compact and steady when at work, and they occupy less space than Horizontal Engines of similar power. They are made either with the cylinder placed upon the bed-plate as shown, or with the cylinder inverted, as shown at various other pages.

STATIONARY STEAM ENGINES
ON
MULTITUBULAR BOILER.

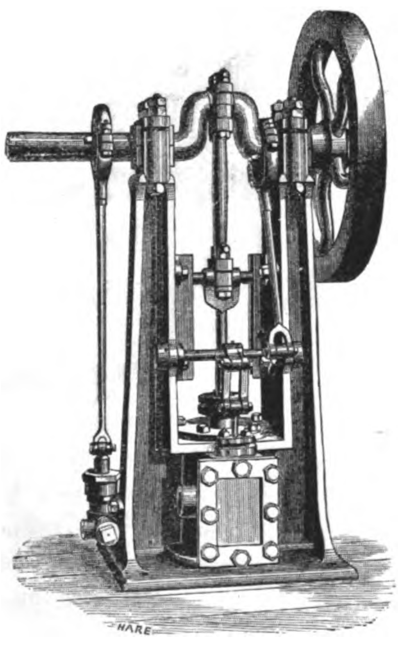
This Engine is precisely on the same construction as the Portable Engines described at page 83, but in lieu of the travelling wheels, a neat base-plate is fitted to the bottom of the fire-box, which is used as an ashes-pan, with flap-door for regulating the draft, and the other end of the Engine is supported on a cast-iron cistern containing the feed-water, rendering unnecessary any outlay for brickwork.

The Prices to 6 horse power are £5 less, and above 6 horse power £10 less, than Portable Engines; dimensions, weights, and other details are same as Portable Engines.

SMALL HORIZONTAL STEAM ENGINES

Are made, finished in a less expensive style than the foregoing; the working parts are thoroughly well finished, but got up principally black; these Engines are complete with fly-wheel, wrought-iron crank shaft, working in bearings of Babbit's patent metal, governors, throttle valve, gun-metal feed pump; the crank pin, joints, &c. work in gun-metal bearings, and the whole is mounted on a cast-iron foundation plate. The Boilers are vertical, and are fitted with all usual mountings, as illustrated at page 93.

Horse Power.	Cylinder.	Stroke.	Price. Engine.			Price. Engine and Boiler.		
	inches.	inches.	£	s.	d.	£	s.	d.
1	3½	7	13	5	0	33	10	0
2½	5¼	9	19	15	0	50	0	0
3	5½	10	27	10	0	63	10	0
4	6⅜	11	37	10	0	87	10	0



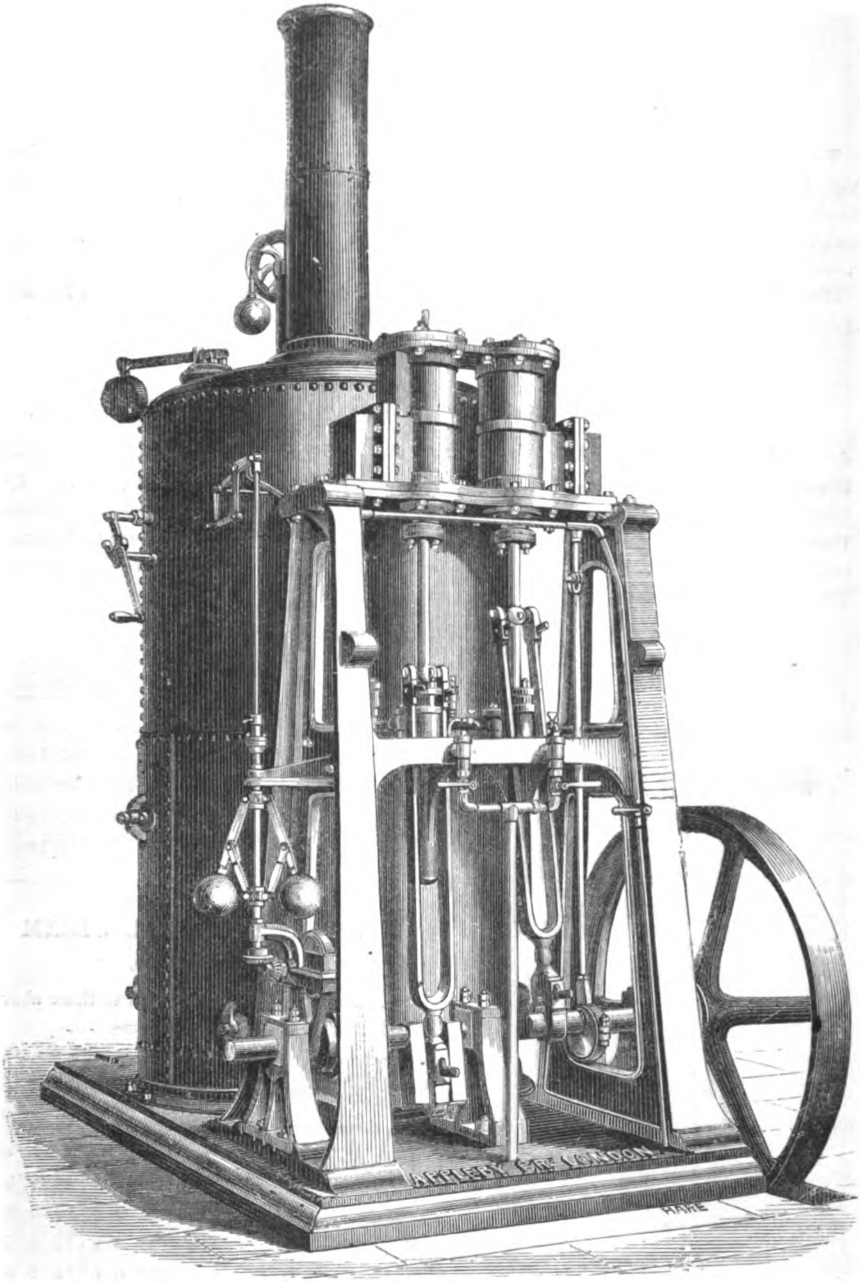
SMALL VERTICAL ENGINE.

SMALL VERTICAL STEAM ENGINES,

Of similar quality and finish to those above described, and as illustrated:—

Horse Power.	Cylinder.	Stroke.	Price. Engine.			Price. Engine and Boiler.		
	inches.	inches.	£	s.	d.	£	s.	d.
1	3½	5	20	0	0	40	0	0
2	4½	6	27	0	0	57	0	0
2½	5½	6	34	0	0	73	0	0
3	6	8	40	0	0	79	0	6

Larger sizes are made of same quality both of Horizontal and Vertical Engines.



VERTICAL ENGINE AND BOILER ON BASE PLATE.

DOUBLE CYLINDER

VERTICAL ENGINE AND BOILER ON BASE PLATE.

The Inverted Cylinder Engine illustrated on the opposite page, is adapted for use in situations where space and cost of erection are important considerations.

The Cylinders are carried on two strong A frames, and the slide valves are on the outer sides of the Cylinders, and are therefore easy of access.

The Crank shaft is fitted with three gun-metal bearings, and it is left long enough to take a broad pulley outside the fly-wheel; the stretcher casting about midway between the cylinders and crank-shaft, carries the two feed pumps; the connecting rods are forked to span the pumps, and are fitted with gun-metal bearings, with straps and cotters at each end. The governors are outside the frame directly over the crank shaft, and are driven by a strap and conical speed pulleys.

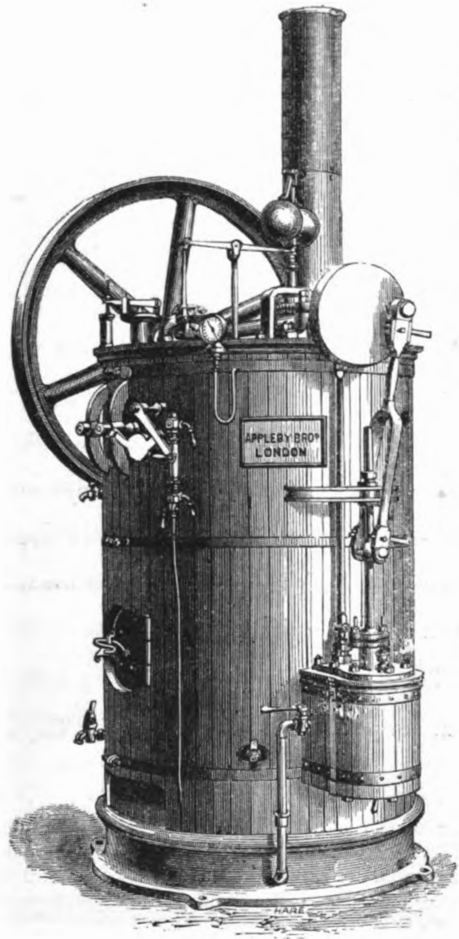
The Engine and Boiler are mounted on one base plate which only requires to be bolted to strong timbers or put down on a bed of concrete.

The prices of the Engines and Boilers, eight horse power and above, with all mountings, are about the same as quoted at p. 73, and the style in which they are got up is the same.

The base plate, carrying an engine of 10 nominal horse power (2 cylinders 7¼ in. diameter) and boiler of ample proportions, occupies a space of 4 ft. 9 in. across the front, and 7 ft. back.

These Engines are sometimes mounted on an iron feed-water tank, which answers the double purpose of giving greater safety when it is necessary to erect the engines on wood floors, and of containing the feed water, and this adds to the price about £12 or upwards.

VERTICAL STEAM ENGINE AND BOILER.



FIXED VERTICAL ENGINE AND BOILER.

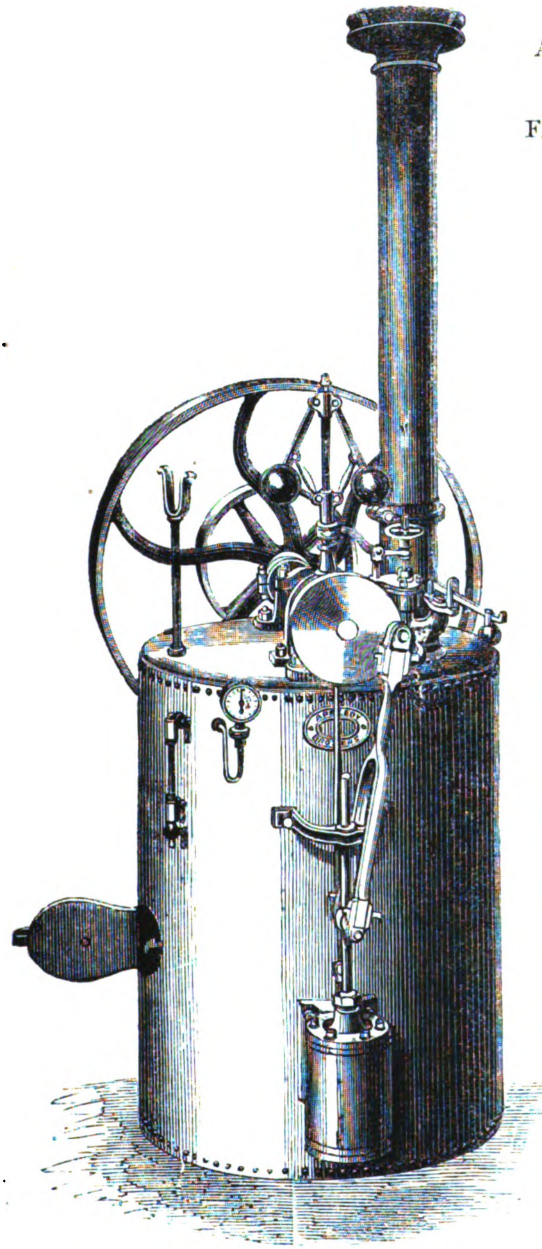
In situations where a compact and neat arrangement is desirable, and where the ordinary brick or stone foundations would be inconvenient, the Engine illustrated has been advantageously employed, and in many cases it has been placed on a boarded floor and immediately set to work.

These Engines have bright cylinder covers with gun-metal glands, metallic pistons and steel piston and valve rods, bright wrought-iron connecting rods with gun-metal straps, and cotters, bright balanced disc-plate, fitted with case hardened crank pin, governors and throttle valve. The crank shaft is of wrought-iron, running in gun-metal bearings; the pump is worked from a gun-metal eccentric, and has a gun-metal clack box and valves, flexible suction pipe and copper rose. The fly-wheel is turned on the face, and is wide enough to take a strap, and the fly-wheel shaft is of sufficient length to take a pulley, and an outside bearing if required.

In addition to the chimney and ordinary furnace mountings, the boiler is fitted with a steam-pressure gauge, safety valve and spring balance, water gauge, two gauge cocks, and blow-off cock.

The whole is mounted on a neat circular cast-iron base, which also forms a water tank, and if required for constant work, the boiler and cylinder should be felted and lagged, as shown in the engraving.

	Cylinders.	Stroke.	Price.	Approximate weight.
3 Horse Power,	5½ inches diameter,	9 inch	£87 10 0	33 cwt.
4 ditto	6½ ditto	10 ditto	126 10 0	45 ,,
6 ditto	7½ ditto	14 ditto	165 0 0	60 ,,



APPLEBY'S VERTICAL FIXED STEAM-ENGINE AND BOILER.

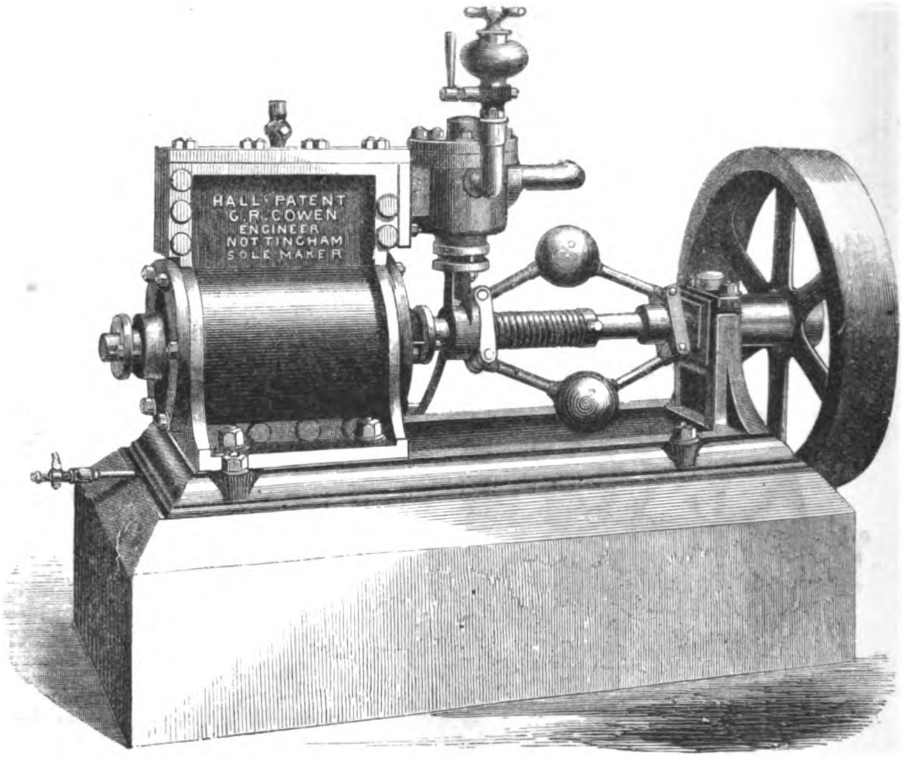
APPLEBY'S FIXED STEAM ENGINE is complete in itself, and is available for use out of doors or in buildings where limited space only can be afforded. By placing the Boiler on a course of brickwork built on a stone slab, it may be worked with perfect safety on an upper floor. The general arrangement of this Engine is same as described for the Portable Engine.

This Engine is sometimes made with an iron base forming a feed-water tank (and rendering it perfectly harmless on a wood floor), and is fully described on page 78,

Horse Power.	Diameter of Cylinder.	Price.	Approximate Weight.
3	5¼ in.	£75	28 cwt.
4	6½ in.	115	37 —
6	7¼ in.	150	52 —

SMALLER VERTICAL ENGINES AND BOILERS are made, similar to that illustrated at page 75, viz.:—

				Approximate Weight.
1 H. P.	3½ in. cylinder	5 in. stroke	£40 0 0	15 cwt.
2 „	4½ „ „	6 „ „	57 0 0	18 „
2½ „	5½ „ „	6 „ „	73 0 0	25 „

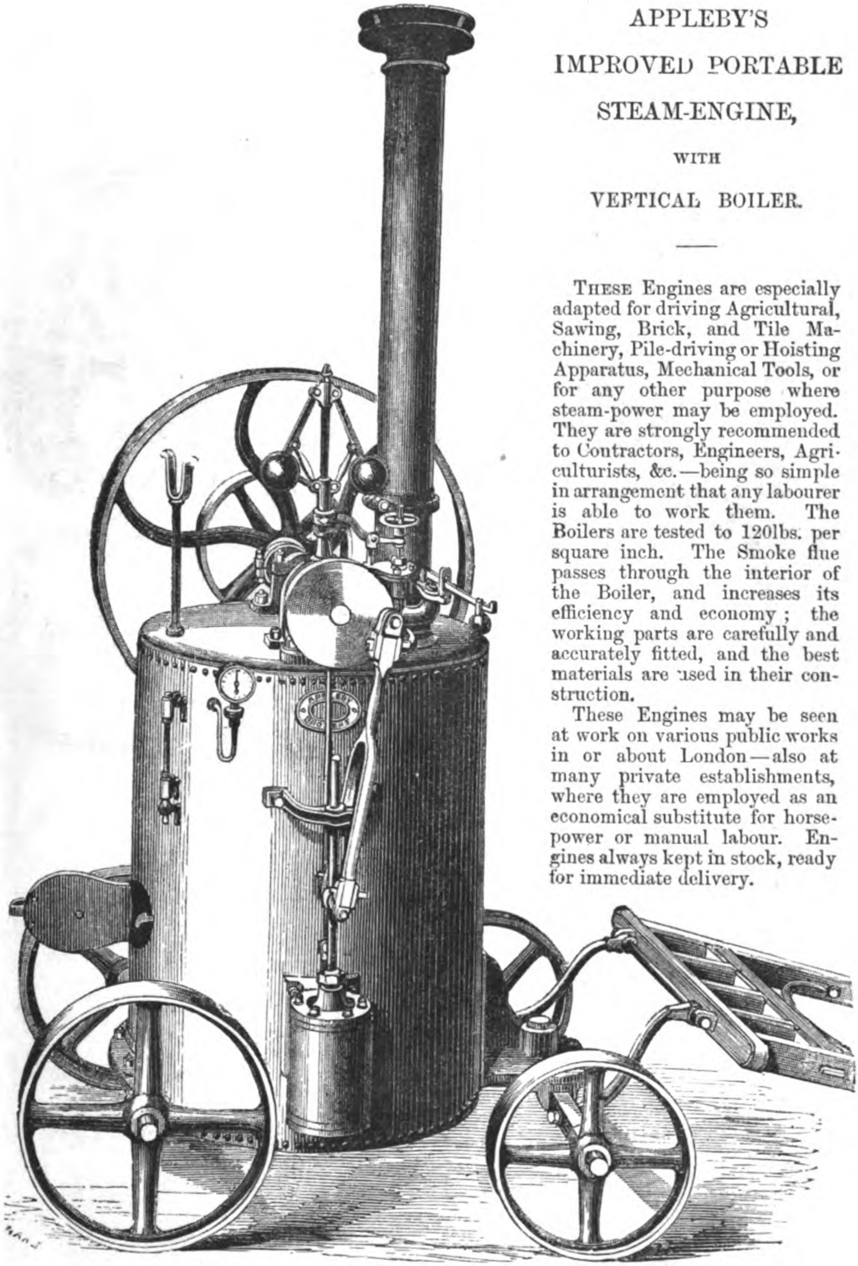


HALL'S PATENT ROTARY ENGINE.

This description of Engine is compact, and from the small number of working parts it is unusually simple.

The main shaft is of steel, and the cut-off valve is worked by the Governors, which gives great regularity in speed under varying loads.

			£	s.	d.
2 Horse power, as shown		Price	18	0	0
4 ,,	with Feed Pump	,,	36	0	0
6 ,,	ditto	,,	48	0	0
8 ,,	ditto	,,	64	0	0
10 ,,	ditto	,,	80	0	0



APPLEBY'S IMPROVED PORTABLE STEAM-ENGINE,

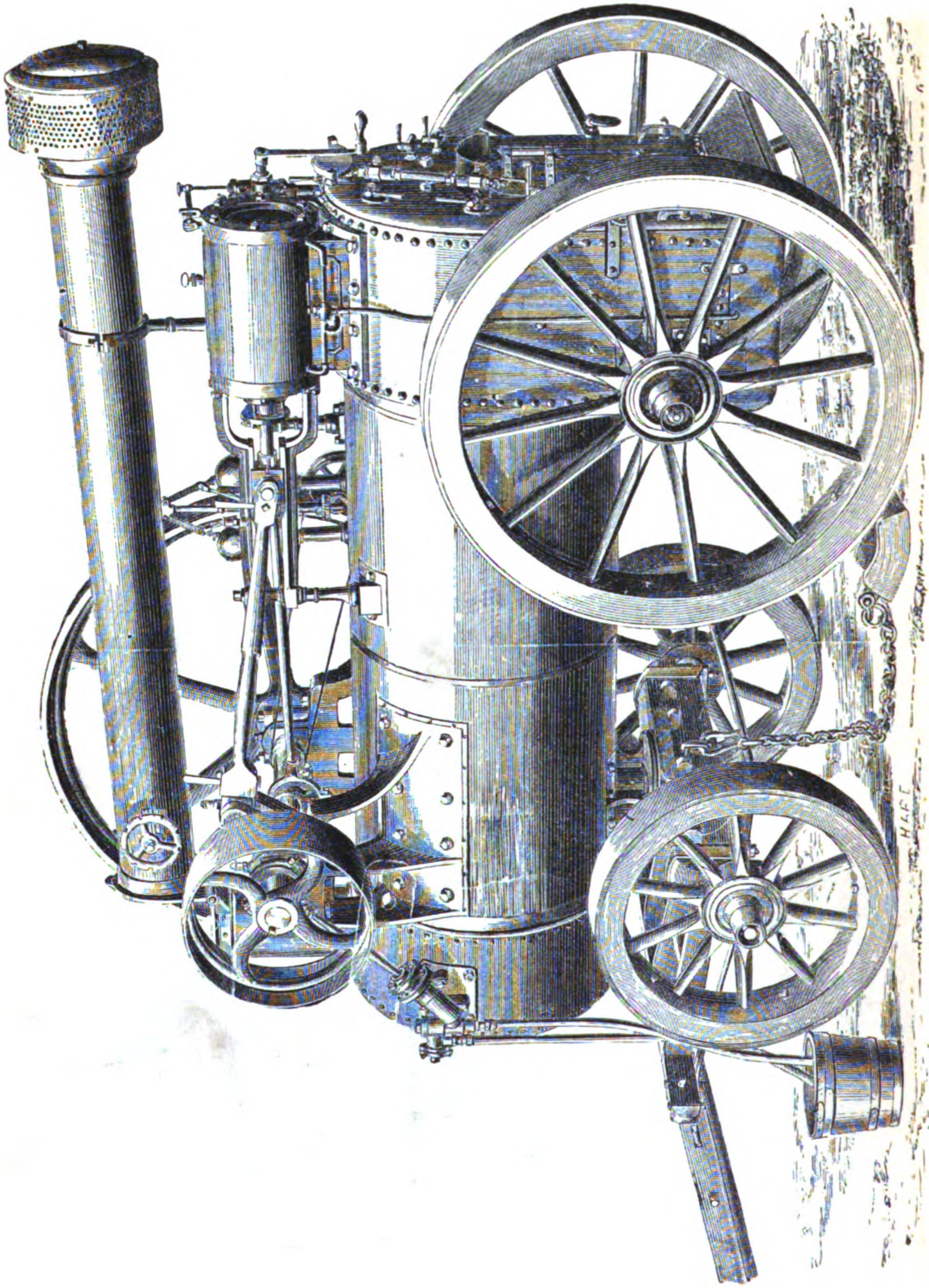
WITH

VERTICAL BOILER.

THESE Engines are especially adapted for driving Agricultural, Sawing, Brick, and Tile Machinery, Pile-driving or Hoisting Apparatus, Mechanical Tools, or for any other purpose where steam-power may be employed. They are strongly recommended to Contractors, Engineers, Agriculturists, &c.—being so simple in arrangement that any labourer is able to work them. The Boilers are tested to 120lbs. per square inch. The Smoke flue passes through the interior of the Boiler, and increases its efficiency and economy; the working parts are carefully and accurately fitted, and the best materials are used in their construction.

These Engines may be seen at work on various public works in or about London—also at many private establishments, where they are employed as an economical substitute for horse-power or manual labour. Engines always kept in stock, ready for immediate delivery.

Horse Power.	Diameter of Cylinder.	Price.	Approximate Weight.
3	5½ in.	£80 0	30 cwt.
4	6½ in.	120 0	40 —
6	7¼ in.	160 0	55 —



HORSE POWER PORTABLE ENGINE WITH MULTITUBULAR BOILER.

IMPROVED PORTABLE STEAM ENGINE,

WITH

MULTITUBULAR BOILER.

This Engine is simple in construction, all the working parts being outside the Boiler, they are easy of access, and the Engines can be worked by any labourer of ordinary intelligence. The Boiler is constructed on the most approved locomotive principle; the Fire-box is made entirely of Lowmoor Iron, and is fitted with Tubes, so arranged as to obtain the maximum amount of heating surface in the least possible space, securing economy in the consumption of fuel, combined with lightness, compactness, and durability. The Boiler is covered with hair-felt, over which is placed a wood lagging; and this is again surrounded by sheet-iron plates.

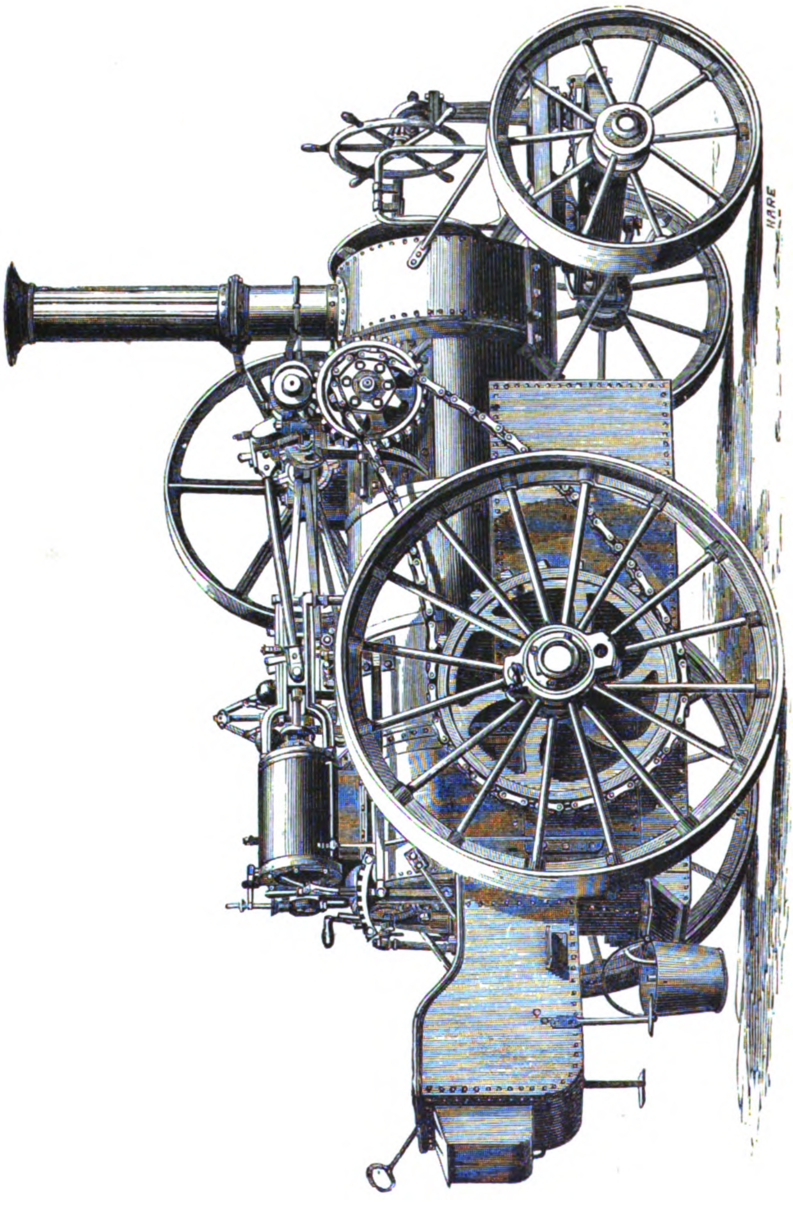
The Engine is mounted on either wood or iron travelling wheels, with patent axles, locking-plate, and shafts. The wood wheels are preferable for Engines having much travelling on bad roads, but iron wheels are most suitable where the removals are not frequent, and are much more durable for tropical climates. Every Engine is thoroughly tested under steam at much above the usual working pressure before leaving the works.

For Exportation it is strongly recommended that all, or a large portion, of the following duplicate parts should be sent out with each Engine, *i.e.*, 2 pairs of main shaft brasses, 1 pair of brasses to large end of each connecting-rod, 1 set of piston-rings and springs, 1 set of furnace-bars, 6 gauge-glasses and rings, 1 tube-brush, 3 boiler-tubes, 6 steel ferrules for ditto, and 1 length of pump suction-hose.

The prices are for Engines complete, with fly-wheel, governors, steam gauge, feed pump, and all necessary valves, and an extra lock-up safety valve, gauges, cocks, &c. also waterproof cover, tube-brush, stoking tools, and funnel.

SINGLE CYLINDER PORTABLE ENGINES.

Horse Power.	Diameter of Cylinder	Revolutions per Minute.	Price.	Large Fire Box for burning Wood.			Packing for Export.			Weight without Case.	Cubic Measurement, packed.	Average Consumption per hour at 45 lb pressure.	
	Inches.		£	£	s.	d.	£	s.	d.	cwts.	feet.	Coal. lbs.	Water. Galls.
2½	5	180	104	1	10	0	2	0	0	30	175	20	13
3	6	180	125	1	10	0	2	5	0	41	205	24	16
4	6½	150	150	2	0	0	3	0	0	49	225	30	20
5	7	125	165	2	10	0	3	15	0	55	285	38	25
6	7¾	125	180	3	0	0	4	10	0	60	330	45	30
7	8½	125	195	3	10	0	5	5	0	66	360	50	35
8	9	125	210	4	0	0	6	0	0	73	390	58	40
9	9½	125	225	4	10	0	6	15	0	77	415	65	45
10	10	110	240	5	0	0	7	10	0	86	445	73	50
12	12	110	270	6	0	0	9	0	0	95	480	85	60
DOUBLE CYLINDER PORTABLE ENGINES.													
10	7	125	260	5	0	0	7	10	0	88	450	73	50
12	7¾	125	300	6	0	0	9	0	0	95	480	85	60
14	8½	125	335	7	0	0	10	10	0	112	540	100	70
16	9	125	375	8	0	0	12	0	0	119	610	115	80
18	9½	110	410	9	0	0	13	10	0	135	720	130	90
20	10	110	445	10	0	0	15	0	0	158	880	140	100
25	12	95	540	12	10	0	18	15	0	172	950	175	125
30	14	90	610	20	0	0	22	0	0	200	1,050	205	150



IMPROVED PATENT AGRICULTURAL LOCOMOTIVE ENGINE.

AGRICULTURAL LOCOMOTIVE.

The general design is similar to that of the ordinary portable engine (see p. 82), with the addition of link motions, larger and stronger travelling wheels, steering apparatus, and a tank to carry a supply of water for about six miles running; the boiler is also made to carry a high working pressure.

The travelling motion is obtained by a pitch chain, driven by a pinion on the crank shaft and passing round a chain wheel on the travelling axle; but two chains, one on each side of the engine, are strongly recommended, not only on account of the additional safety, but also for facility in turning, when either pinion can be thrown in or out of gear, and when the engine is used for driving machinery, both pinions are thrown out of gear. The travelling gear is fitted with Aveling's patent apparatus for tightening the chain. The boiler is fitted with a lock-up safety valve and all necessary mountings.

PRICES.

Horse-power.	8	10	12
	£ s. d.	*£ s. d.*	*£ s. d.*
With one cylinder and one driving chain	350 0 0	380 0 0	
With one cylinder and two driving chains	360 0 0	390 0 0	
With two cylinders and one driving chain		410 0 0	465 0 0
With two cylinders and two driving chains		420 0 0	475 0 0

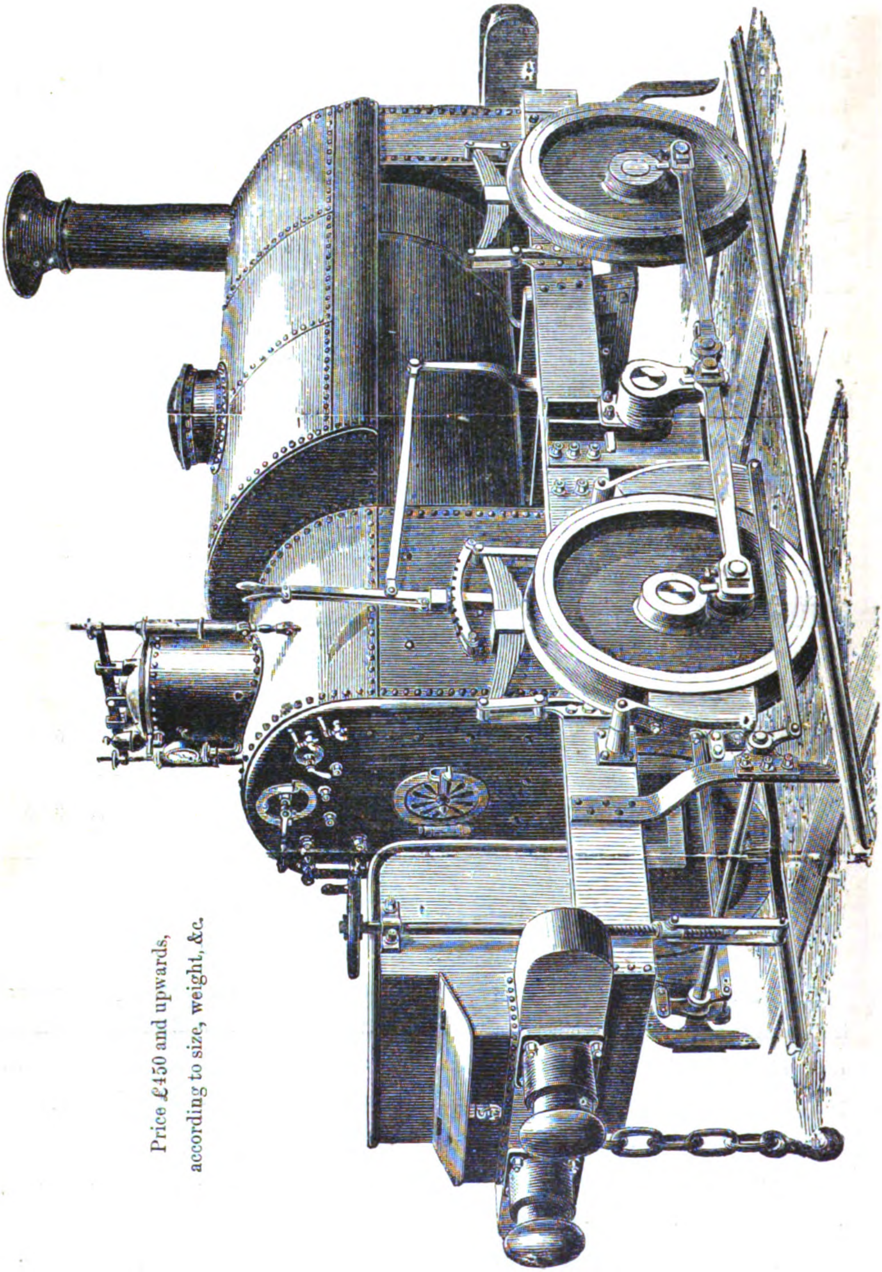
WINDMILLS OR WIND ENGINES.

The Wind Engine is a cheap and simple means of obtaining power in many places where it is difficult to adopt steam or other motive power. It is most economical in working, is very easily managed, and when once set at work requires no further attention, the sails shifting their position as the wind changes. It is especially applicable for driving Pumps, and equally so for corn grinding, thrashing, sawing timber, or for any other machinery.

The prices of self-regulating Wind Engines of the most recent and best construction are, exclusive of timber framing:—

Horse Power .	½	1	1½	2	3	4	6	8	10	12
Each	£35	£45	£60	£85	£110	£130	£180	£225	£275	£310.

SADDLE TANK LOCOMOTIVE FOR CONTRACTORS OR BRANCH LINES.



Price £450 and upwards,
according to size, weight, &c.

TURBINES.

TURBINES are found to possess many advantages over the ordinary water wheel as a means of applying water power, and they are usually much cheaper in cost, especially for high falls, whilst with low falls they greatly excel undershot and breast-wheels in economising the water, or, in other words, with the same volume and fall, more power is obtained from the Turbine than from the water wheel. Their action is not impeded by back-water, consequently they may be placed at or below the level of the tail-race ; the entire fall is thus rendered available at all times, whilst the ordinary wheels (for low falls especially) in order to be out of back-water in floods, often require to be placed so high, as in dry weather to cause an important part of the fall to be wasted in the tail-race. The speed at which Turbines revolve is such, that the machinery can generally be driven direct, and they can be employed in many situations where a cumbrous vertical wheel would not be available. The Turbines most generally used are the following :—1stly, Fournegron's, with an "outward flow," admitting the water in the centre of the wheel, and discharging it at the circumference ; 2dly, Thompson's vortex wheels, with an "inward flow," which admits the water at the circumference, and discharges it at the centre ; and lastly, Fontaine's and Jonval's "parallel flow" wheels ; these are placed with their axes vertical, and the vanes, which are fixed round the outer circumference of the wheel, receive the water on their top and discharge it below ; thus the water passes through parallel to the axis.

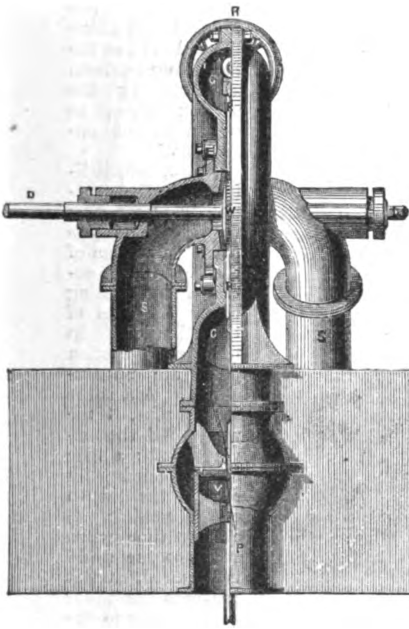


Fig. 1.

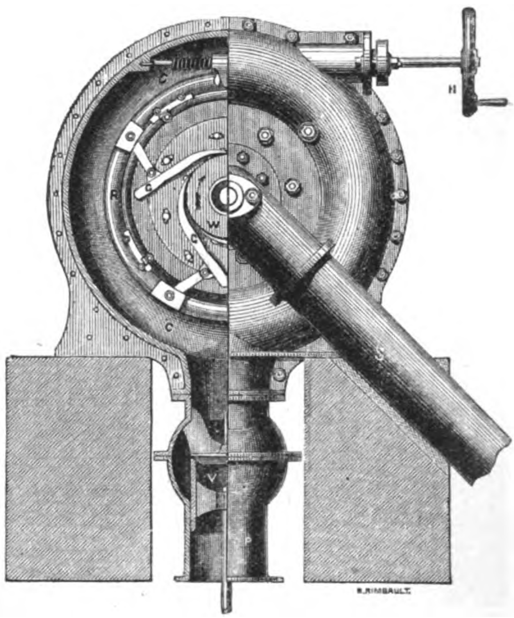


Fig. 2.

Figs. 1 and 2 represent one of Thompson's Vertical Vortex Wheels. One-half of each view is in section, showing the internal arrangement. The water enters through the pipe (P) into the annular chamber (C), from whence it is conducted by four guide blades (G G) into the revolving wheel (W), and is discharged at the centre. The two suction pipes (S S) convey it to the tail-race. The revolving wheel (W) is keyed on the main driving shaft (D) ; an equilibrium

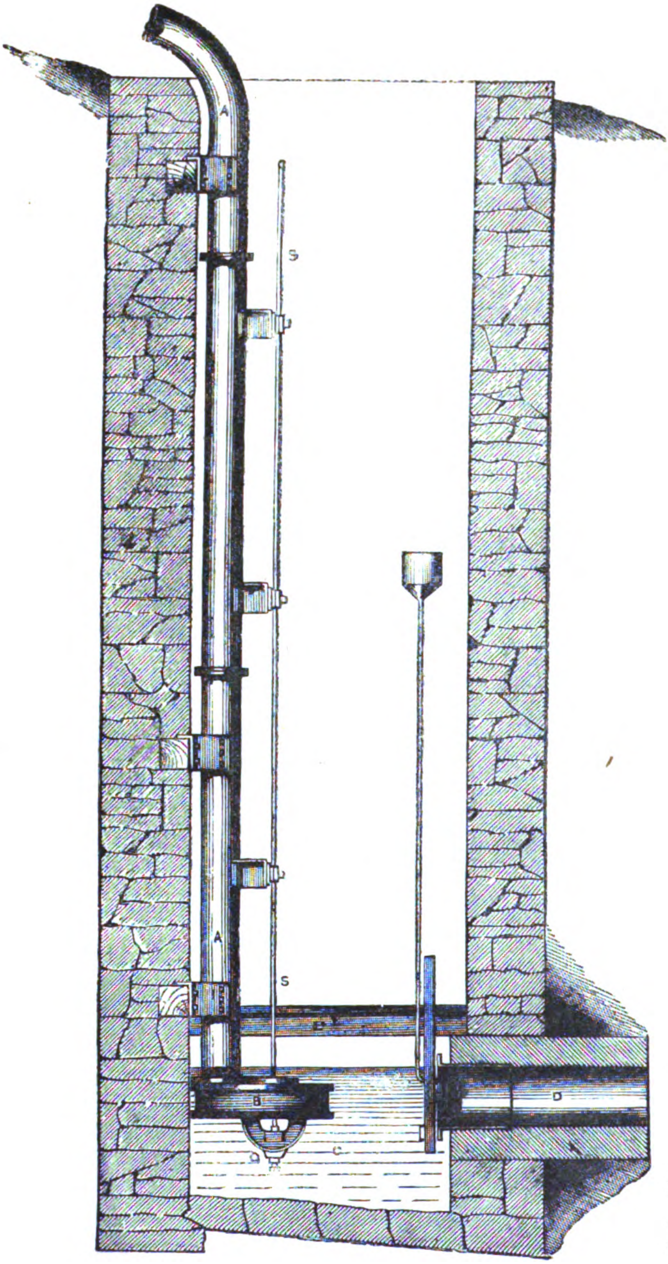


Fig. 3.

valve (V) is placed in the supply pipe for shutting off the water. The guide blades (G G) are hinged at their inner points, which enables their angle to be varied by a series of levers, which are worked by the band-wheel (H). This arrangement is only necessary when the power required varies considerably at different times, and the saving of water is important. When the power required is constant, the guide blades are made fixed. The wheel may be placed at any height (less than 30 feet) above the tail-race, as the fall will be rendered available by the suction pipes, as shown in the engraving.

Fig. 3, which illustrates the position in which this wheel is sometimes placed, a portion of the fall being obtained by cutting below the level of the mill floor. In this case suction pipes are not required. A A is the supply pipe, B the wheel, S S the driving shaft; a slide is provided for closing the mouth of the conduit (D) at any time when access to the wheel is required, and it prevents the water flowing back to the pit from the river into which the tail-race leads.

The annexed list will give a general idea of the cost of turbines, but the powers required, and the height of fall

available are so varied, that modifications of construction and arrangement are often desirable; it is therefore impossible to compile a table sufficiently comprehensive to be universally applicable. The prices given for the several parts will vary with fluctuations in the price of metals, but it is not probable that those fluctuations will be so great as to cause the prices quoted to be much exceeded.

Power.	Height of Fall.	Quantity of Water, in cubic feet per minute.	Revolutions per minute.	Cost of Vortex.	Extra, if with moveable guide blades.	Size of Pipes.	Cost of Pipes per foot.	Cost of Pen Trough.
H. P.	Feet.			£ s. d.	£ s. d.	Inches.	£ s. d.	£ s. d.
6	15	282	247	63 0 0	16 17 6	16	0 16 6	10 2 6
6	20	212	341	56 5 0	15 15 0	14	0 14 5½	9 11 8
6	25	169	446	50 12 6	14 12 6	13	0 12 1½	9 0 0
6	30	141	567	47 5 0	13 10 0	12	0 10 4	8 8 9
6	40	106	811	42 15 0	11 5 0	10	0 6 11½	7 17 6
6	50	85	1057	39 7 6	11 5 0	9	0 6 8½	7 17 6
8	15	377	207	73 2 6	20 5 0	18	0 18 5½	12 7 6
8	20	282	296	65 5 0	16 17 6	16	0 16 6	10 2 6
8	25	226	391	59 12 6	15 15 0	14	0 14 5½	9 11 8
8	30	188	491	55 2 6	14 12 6	13	0 12 1½	9 0 0
8	40	141	700	49 10 0	13 10 0	12	0 10 4	8 8 9
8	50	113	929	45 0 0	11 5 0	10	0 6 11½	7 17 6
10	15	471	185	83 5 0	22 10 0	21	1 0 10	14 12 6
10	20	353	264	74 5 0	19 2 6	18	0 18 5½	11 16 8
10	25	282	350	66 7 6	16 17 6	16	0 16 6	10 2 6
10	30	235	439	61 17 6	15 15 0	14	0 14 5½	9 11 8
10	40	176	630	56 5 0	14 12 6	13	0 12 1½	9 0 0
10	50	141	830	51 15 0	13 10 0	12	0 10 4	8 8 9
16	15	706	150	112 10 0	28 2 6	24	1 9 3	22 10 0
16	20	529	216	95 12 6	23 12 6	22	1 1 11½	18 0 0
16	25	423	285	84 7 6	20 5 0	20	0 19 8½	14 1 3
16	30	353	359	76 10 0	19 2 6	18	0 18 5½	11 16 8
16	40	265	513	67 10 0	16 17 6	16	0 16 6	10 2 6
16	50	211	680	61 17 6	15 15 0	14	0 14 5½	9 11 8
20	15	941	130	135 0 0	31 10 0	28	1 14 4	28 2 6
20	20	706	187	114 15 0	28 2 6	24	1 9 3	22 10 0
20	25	565	247	101 5 0	24 15 0	22	1 1 11½	18 11 8
20	30	471	310	92 5 0	22 10 0	21	1 0 10	14 12 6
20	40	353	445	81 0 0	19 2 6	18	0 18 5½	11 16 8
20	50	282	588	74 5 0	16 17 6	16	0 16 6	10 2 6
30	15	1412	107	180 0 0	39 7 6	36	2 3 10½	39 7 6
30	20	1059	152	153 0 0	33 15 0	30	1 16 7	31 10 0
30	25	847	201	135 0 0	30 7 6	27	1 12 11	27 0 0
30	30	706	253	122 12 6	28 2 6	24	1 9 3	22 10 0
30	40	529	363	108 0 0	23 12 6	22	1 1 11½	18 0 0
30	50	423	480	99 0 0	20 5 0	20	0 19 8½	14 1 3

The prices of the pipes given above are up to 18 in. diameter for cast-iron flange pipes, with bolts, joint rings, &c. The sizes above 18 in. diameter are of wrought-iron. Bends extra.

The pen troughs are fitted with cast-iron strainers and sluice valves.

Turbines on the Jouval principle are illustrated by the accompanying Figures. As before mentioned, the water in this system acts perpendicularly or parallel with the vertical driving shaft. It is directed through an annular ring of guide blades set at the required angle, and acts against a series of vanes fixed at an opposite angle on the circumference of the revolving wheel. The power of these wheels is regulated by an arrangement for partially closing the water passages through the guide blades.

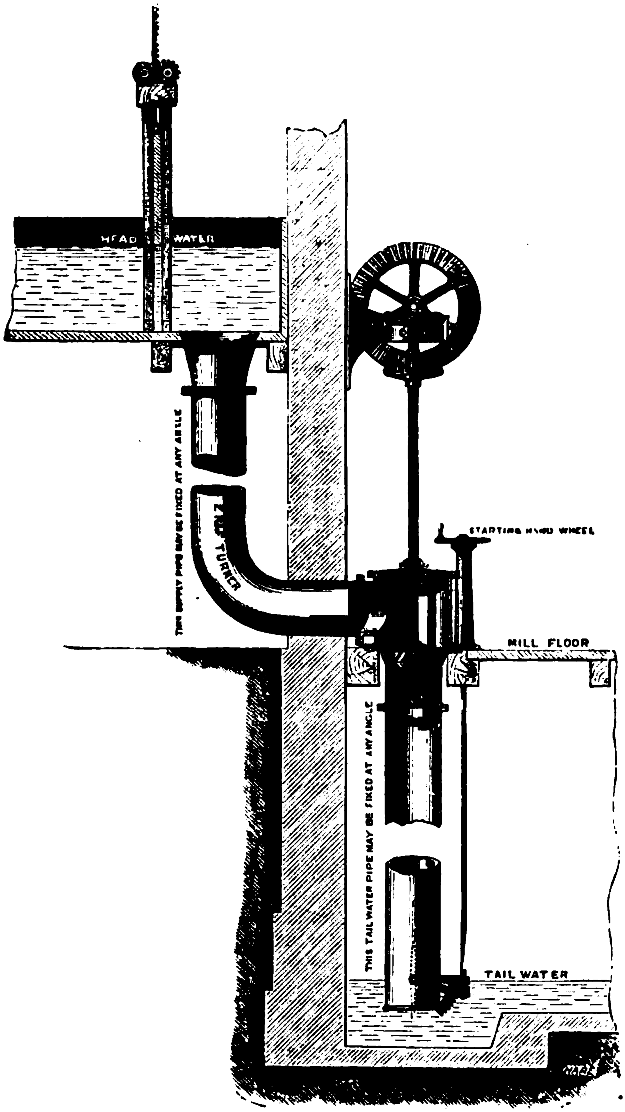


Fig. 4.

Fig. 4 represents one of these wheels as erected, and adapted for medium or high falls.

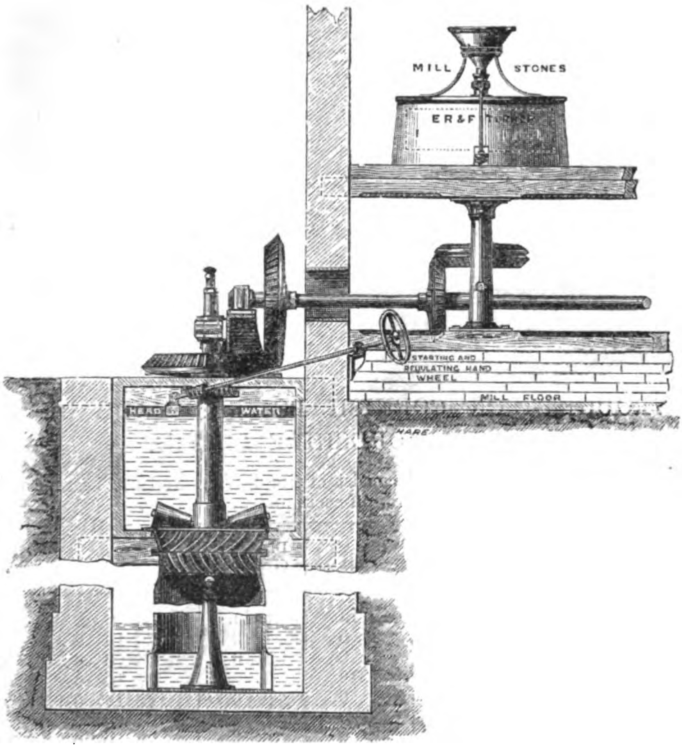


Fig. 5.

Fig. 5 gives the arrangement of one with gearing and mill stone, suitable for low falls.

The following particulars should accompany inquiries for estimates for any class of Turbines :—

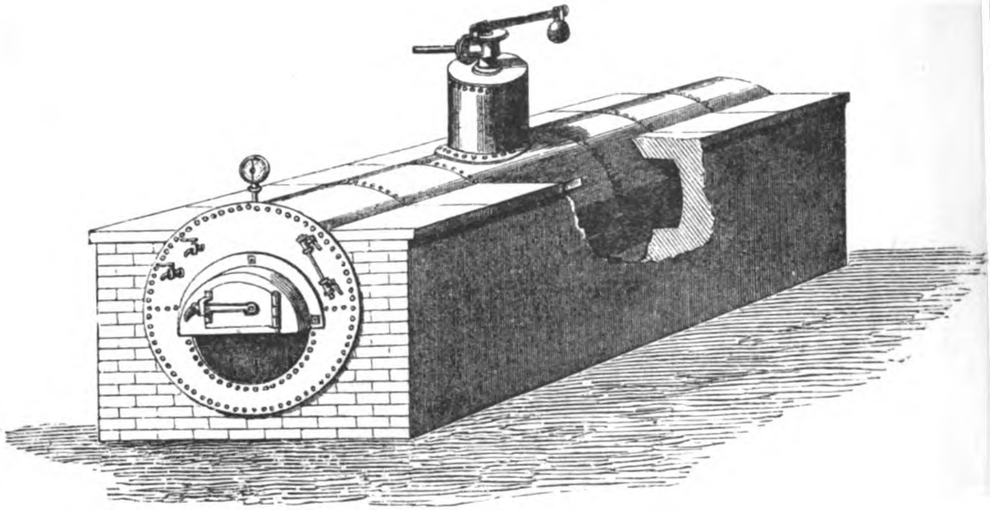
The quantity of water, or assuming the quantity to be sufficient, the power required.

The total fall from the surface of the head to the tail-water at the usual working levels.

The length of pipes required (the water should be brought in an open cutting or timber trough, as far as convenient, so as to shorten the length of pipe, and all sharp bends should be avoided as much as possible.

The particulars of the gearing and length of driving shaft.

The nature of the machinery to be driven, and speed of same.



WROUGHT-IRON CORNISH BOILERS MADE OF BEST STAFFORDSHIRE PLATES.

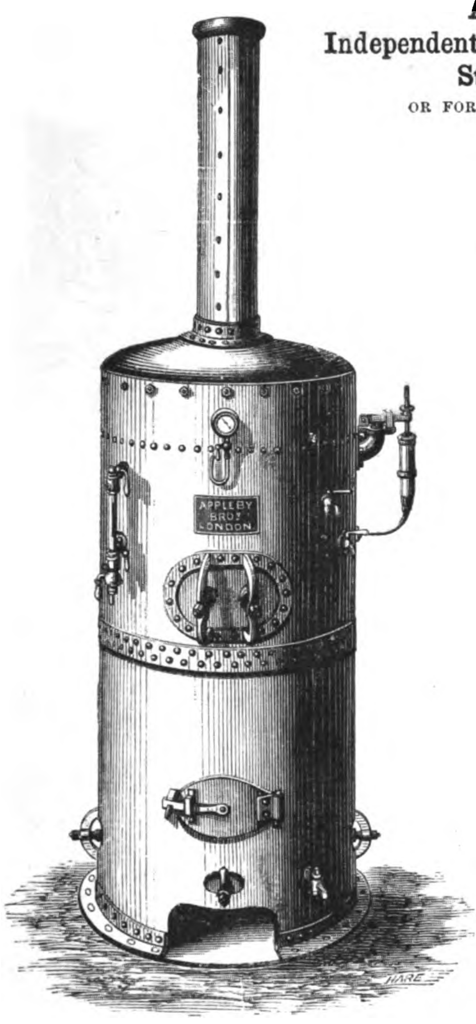
If with fittings, the fittings will consist of fire-door, grate-bars, bearers and dead-plate, stop-valve, safety-valve, feed-valve, blow-off-cock, and water-gauge.

Horse Power.	Length.	Diameter.	Size of Tube.	Diameter of Dome.	Price.	Price with Fittings.
	ft. in.	ft. in.	ft. in.	ft. in.	£ s. d.	£ s. d.
3	8 6	3 0	1 6	1 3	26 10 0	41 10 0
4	10 0	3 3	1 8	1 6	34 0 0	49 0 0
6	10 0	3 6	1 10	1 8	37 10 0	56 10 0
8	12 0	4 0	2 0	2 0	48 10 0	69 10 0
10	14 0	4 3	2 3	2 0	61 0 0	84 0 0
12	15 0	4 9	2 6	2 0	74 0 0	100 0 0
16	19 0	5 0	2 9	2 0	96 0 0	125 0 0
20	22 0	5 3	3 0	2 3	115 0 0	146 0 0
25	25 0	6 0	3 0	2 6	142 0 0	173 0 0
30	30 0	6 0	3 0	2 9	165 0 0	196 0 0

EGG-ENDED BOILERS OF BEST STAFFORDSHIRE PLATES.

Horse Power.	Length.	Diameter.	Price.
	ft. in.	ft. in.	£ s. d.
3	10 0	3 0	19 0 0
4	11 0	3 0	21 10 0
6	14 0	3 6	31 0 0
7	14 0	4 0	36 0 0
8	16 0	4 0	40 10 0
10	20 0	4 0	50 0 0
12	24 0	4 0	60 0 0
16	28 0	4 6	79 0 0
20	28 0	5 9	98 0 0

LOCOMOTIVE, MARINE, AND OTHER BOILERS TO DRAWING OR SPECIFICATION.



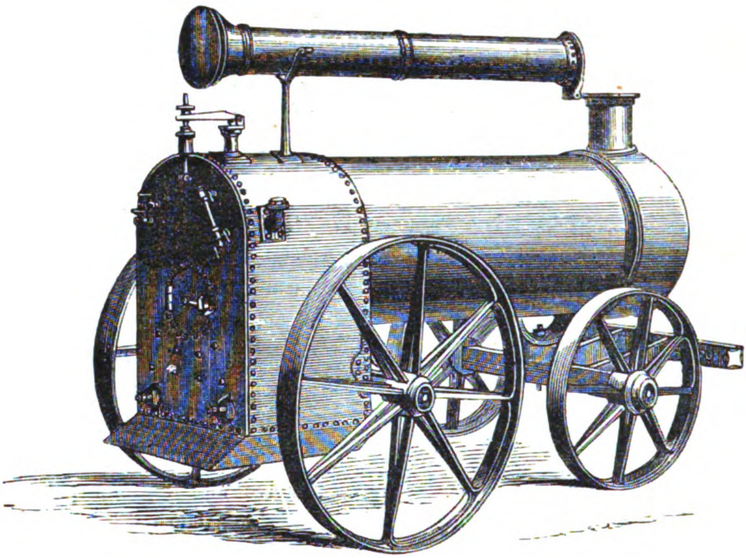
APPLEBY'S
Independent Boilers for Working Steam Pumps,
OR FOR ANY OTHER PURPOSE.

VERTICAL multi-tubular boilers, on iron base, requiring no brick work, setting, or foundations, and complete with chimney, fire door, fire bars and bearer, mud holes, man hole strengthened with wrought-iron ring, covers and bridge pieces, and fitted with safety-valve and Salter's patent spring balance, water gauge, gauge cocks and blow-off cock, the whole tested by hydraulic pressure to 150 lbs.; the working pressure being 40 lbs. to 50 lbs. per square inch.

If the feed-water has much sediment or tendency to incrustation, plain fire boxes are preferable, and will be supplied at the same prices as the multi-tubular boilers above specified.

BOILER AS DESCRIBED ABOVE:—			Price.		Extra if Felted and Lagged.
2 H.P. Suitable for working pumps		Nos. 1 and 2	£30	...	£6
3 „ Ditto	ditto	Nos. 3 and 4	36	...	7
4 „ Ditto	ditto	Nos. 5, 6, 7, and 8	50	...	8
6 „ Ditto	ditto	No. 9	60	...	10
8 „ Vertical Boilers, as above			80	...	12
10 „ Ditto	ditto		90	...	13
12 „ Ditto	ditto		105	...	15

Larger sizes are made to special estimate.



PORTABLE BOILER AND APPLEBY'S INDESTRUCTIBLE WROUGHT-IRON WHEELS.

PORTABLE MULTITUBULAR BOILERS,

Horse Power.	*BOILERS. Price.	†BOILERS MOUNTED. Price.
4	£43 0 0	£66 10 0
6	57 0 0	81 0 0
7	62 10 0	87 0 0
8	67 0 0	95 0 0
10	83 0 0	116 0 0
12	100 0 0	133 0 0

* Includes fire-door, ashes-pan, man-hole, mud-holes and covers, stays, chimney, and smoke-box.

† Includes ditto, ditto, and with wood or iron wheels, axles, locking-plate, fore-carriage, shafts, water-gauge, pet-cock, blow-off-cock, grate-bars, &c.

APPLEBY'S PATENT WROUGHT-IRON INDESTRUCTIBLE WHEELS,

Specially invented and adapted for hot or cold climates, combining the greatest amount of strength with lightness and durability.

3 0 diameter	per pair	£7 0. 0	Other sizes if required.
3 6 ,,	,,	£7. 10. 0	
4 0 ,,	,,	£8. 0. 0	
4 3 ,,	,,	£8. 10. 0	

These are admirably adapted for Gun Carriages.

FIG. 1.

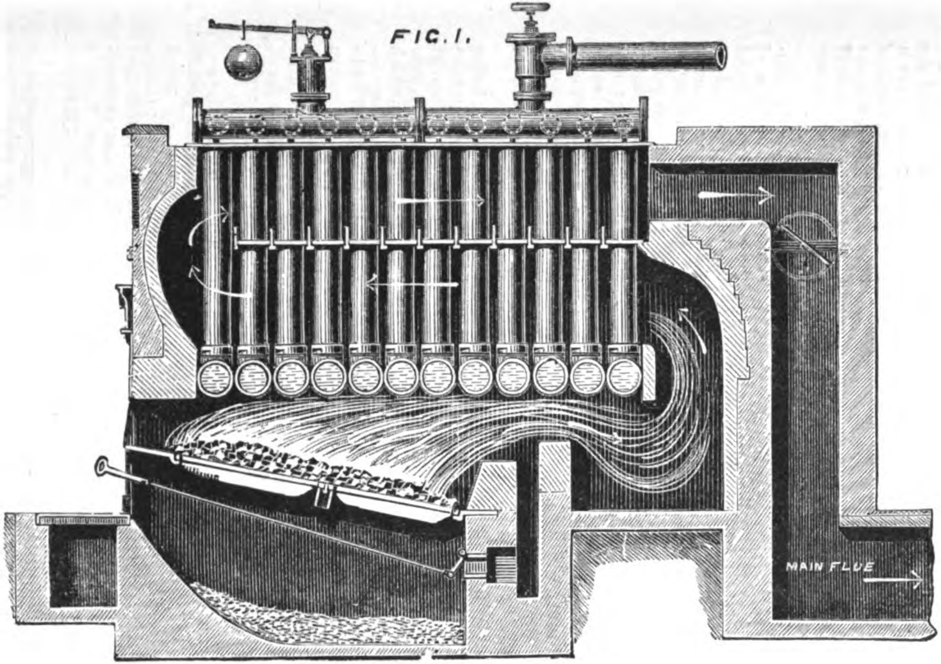
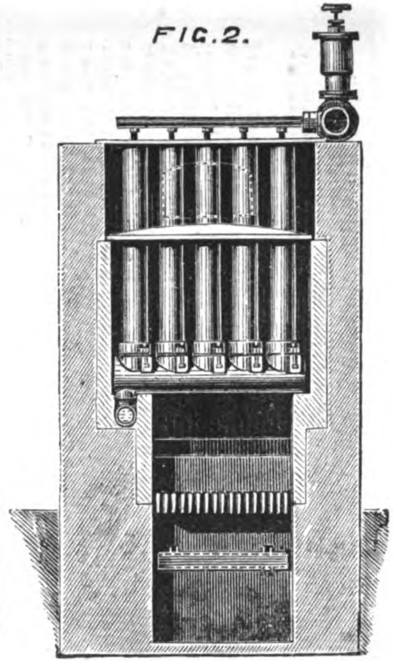


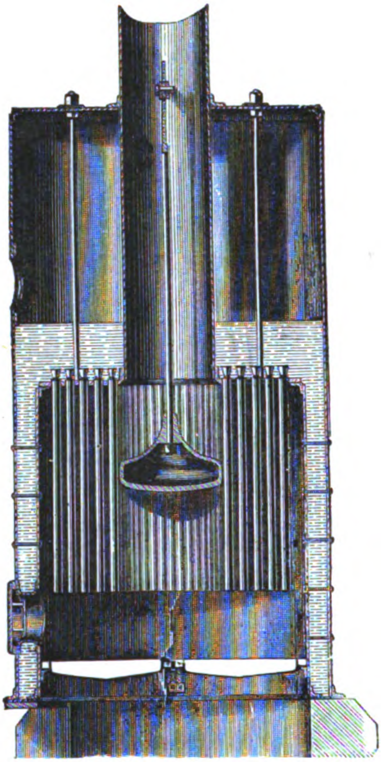
FIG. 2.



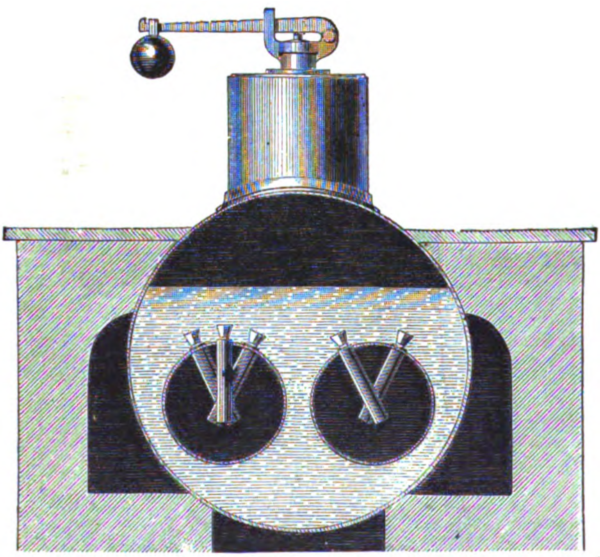
HOWARD'S PATENT STEAM BOILERS.

THESE Boilers are built up of Wrought-iron Tubes, the bursting pressure of which is at least 2,000 pounds per square inch, and the whole of the steam pipes and connections are tested to a pressure of 500lbs. per square inch. Each tube has within it an internal one, rising up through the water space, dividing the water into annular and central columns, which causes a very active circulation, and a corresponding economy in the consumption of fuel. The upper parts of the tubes forming the steam space being exposed to the radiated heat of the heating chamber. The steam is taken off dry, or it may even be superheated. No bolt or joint is exposed to the action of the fire, and each part is so light that a boiler of considerable power can be transported over bad roads or through mountainous districts.

The cost of these Boilers is about the same as that of Cornish Boilers of equal power, and the cost of packing for shipment is about five per cent. on the price.



THE "FIELD" BOILER.



CORNISH BOILER, SHOWING APPLICATION OF THE "FIELD TUBES."

THE "FIELD" PATENT BOILER

Is a multitubular boiler of that description which is generally called "tubulous," to distinguish it from the ordinary kind, where the water is outside the tubes and the fire passes through the tubes. In this boiler the water is inside the tubes, which hang down into the fire, by which they are surrounded on all sides, thus exposing the whole of the tube-heating surface to a temperature of upwards of 3000 degrees, no doubt one of the reasons why it gives far better results than any other similar boiler.

It has now been in constant use for upwards of three years, and is found to yield good practical results, combining economy of space with economy of fuel; and as an example it may be mentioned that a 50-horse power boiler only occupies a ground space of 6 feet 6 inches square, whereas two 25-horse power Cornish boilers would occupy a ground space of 450 square feet.

The weight of this boiler is considerably less than that of other boilers of equal power, and it only requires a foundation, which forms the ash-pit; but beyond this no setting-in brickwork or expensive chimney-stack is required, as a suitable wrought-iron chimney is always used, and supplied with the boiler. In Cornish and cylindrical boilers, the setting and the chimney-stack frequently cost as much as the boiler itself; it will, therefore, be found that the Field Boiler is considerably cheaper than a Cornish Boiler of the same power.

In the consumption of fuel it has proved itself more economical than any other description of steam

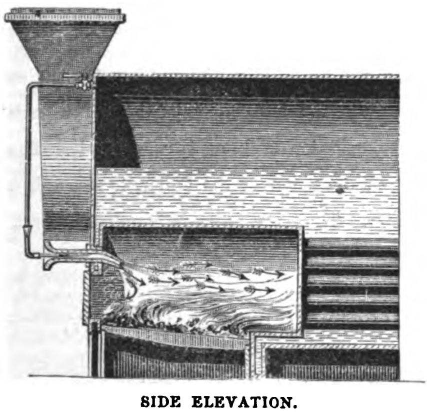
generator, which is due to the fact that the whole of the heating surface is exposed to the hottest part of the flame, and also due to the very powerful circulation of water which is caused by the peculiar arrangement of the double tubes; and this circulation is the more rapid and efficient the greater the difference between the temperature of the water and the fire. The principle of the invention is as follows: the outer tube is closed at the bottom end but open at the top, and a smaller tube is inserted within the outer one, open both at top and bottom, to allow a free circulation of the water. The heated water and steam in the outer tube, in immediate contact with the fire, passes rapidly upwards into the boiler, whilst the solid and cooler water descends in the inner tube to take the place of the ascending current, whereby a constant circulation is produced, making steam very rapidly, and not allowing any sediment or scale collecting in the tubes, and further, preventing priming entirely. A cylindrical baffleplate, merely a lump of cast-iron, is suspended at the entrance to the chimney-tube, to prevent the fire from going straight up into the chimney, and to compel it to distribute itself amongst the tubes.

The Field Tubes are readily inserted into any existing boiler, either horizontal or vertical, that may require a larger heating power, and they are as easily removed for cleaning or examination. They are applied in a variety of ways according to circumstances. In any inquiries respecting the Field Boilers or Tubes, the fullest possible information should be given as to the actual power required, size of cylinder and stroke of piston of the engine to be driven, together with place of cut off from the commencement of the stroke, the number of revolutions, and the steam pressure at which it is desired to work, and the thickness of the plate into which the tubes are to be inserted, if applied to an old boiler.

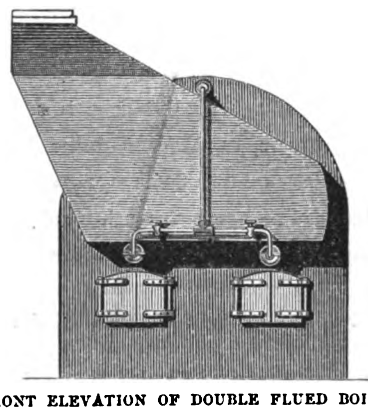
Finally, as a proof of the popularity which the Field Boiler has attained, it may be mentioned that 170 of them are now at work, and 55,000 tubes have been made since the commencement.

The price of the tubes generally applied to Cornish and Lancashire boilers is 6/6 each, complete and ready for fixing.

WATKIN'S PATENT STEAM INJECTING SMOKE-CONSUMER



SIDE ELEVATION.

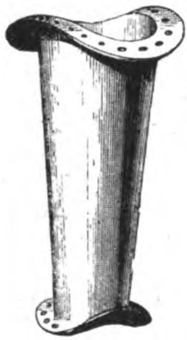


FRONT ELEVATION OF DOUBLE FLUED BOILER.

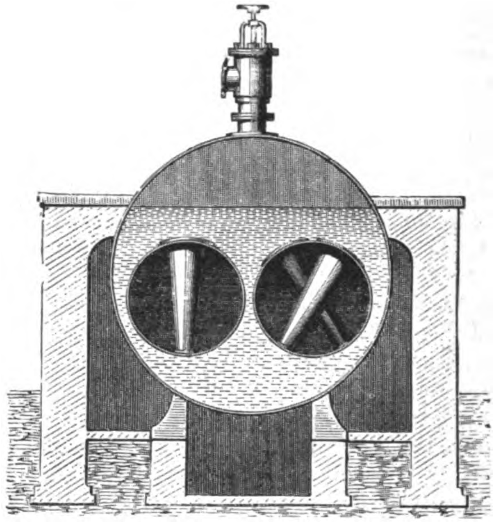
Is applicable to all kinds of Steam Boilers, Stationary, Marine, Locomotive; also to Coiling, Puddling, or Smelting Furnaces, Cupolas, Reverberatories, Forges, &c. It is extensively used in the different departments of Her Majesty's Service, and in various large public and private establishments.

The principle of this apparatus is so simple, that it will be readily understood from the engravings; it possesses eminently the advantages of consuming and preventing smoke even when using the poorest kinds of coal or slack, cannot easily be put out of order, is easy of application, simple of construction, cheap in first cost, and economical in working.

Price of the apparatus, fixed on a Boiler with a single fire,—inclusive of Royalty,—
if in London £10



"GALLOWAY" PATENT TUBE.



SECTION OF CORNISH BOILER, SHOWING APPLICATION OF "GALLOWAY TUBES."

GALLOWAY'S PATENT CONICAL WATER TUBES FOR STEAM BOILERS.

THESE Tubes are adapted for introduction into any existing Cornish or other Boilers, as the amount of taper in their form is sufficient to allow the bottom flange to pass through the hole in the upper side of the boiler flue, and the operation of fixing is very simple. The advantages derived from their use are to greatly increase the power of the Boiler, to strengthen the flues, and promote a thorough circulation of water. Their use is becoming very general, and any Boiler-maker can apply them.

PRICES AT THE WORKS, INCLUDING ALL CHARGES FOR ROYALTY.

Patent Tubes,	not exceeding	3 ft. long	55/0 each
Ditto	ditto	3 ft. 6 „	60/0 „
Ditto	ditto	4 ft. „	65/0 „

NOTE.—In ordering these Tubes, it is necessary to give exact dimensions of the internal diameter of flue, and thickness of plates, or the length of tube from inside of one flange to outside of the other flange.

DREDGERS FOR CANALS, DOCKS, RIVERS, &c.

Dredgers for the purposes indicated are so often required for temporary use under circumstances where a large outlay is undesirable, that the authors have found it necessary to construct an efficient and inexpensive tool, and this has been effected in the following manner:—

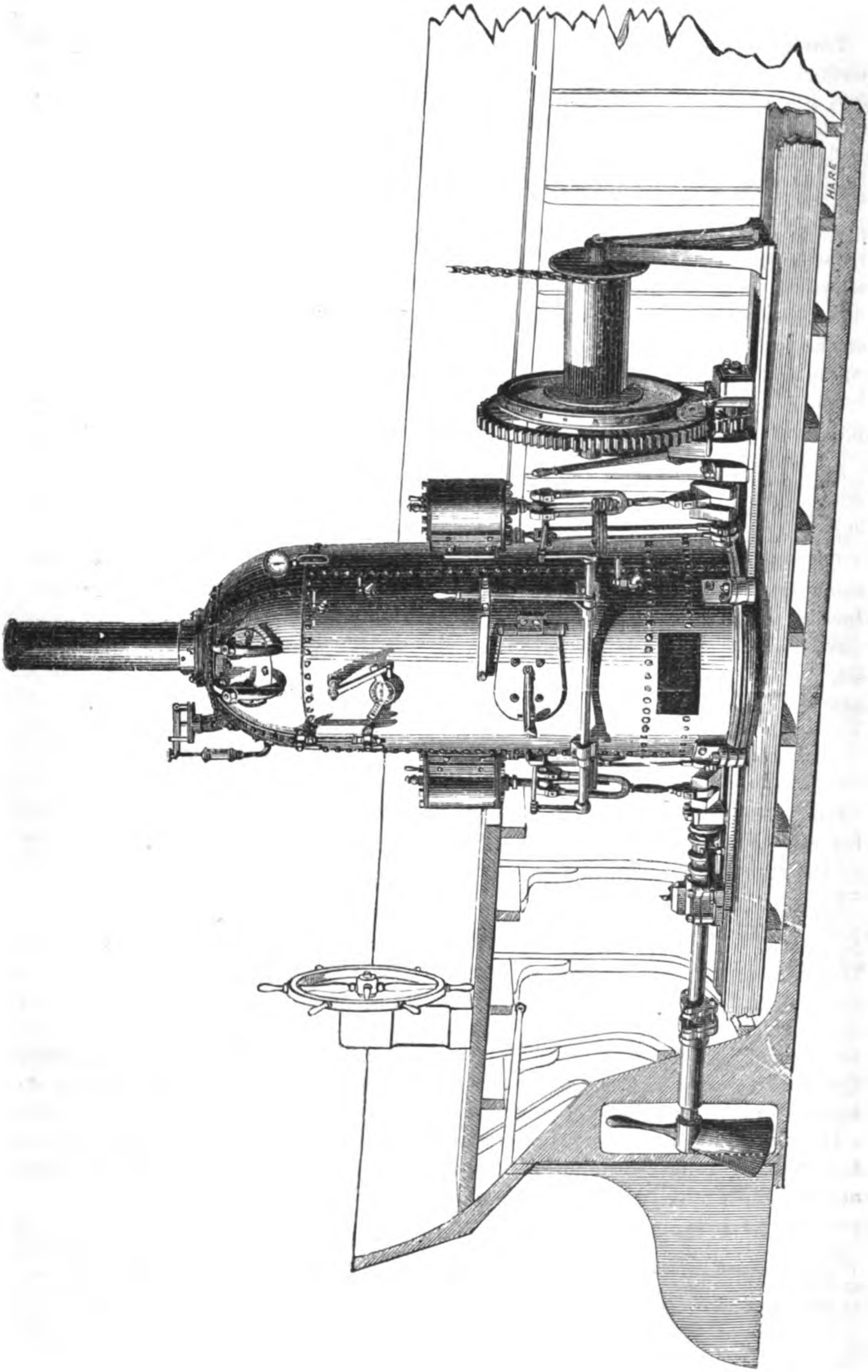
A pair of strong cast-iron frames, to carry the whole of the gear, are bolted to timbers usually about twelve inches square, and these are fixed athwart an ordinary barge (say 30 to 80 tons burden) proportioned to the work to be done, one being close to the side, and the other about the middle of the barge; these frames are fitted with bearings for the cam shaft, the extreme end of which is carried by a hanger from two timbers attached to the top of the frames. The top Cam is five-sided, working in gun-metal bearings, and the bottom Cam is four-sided and works in chilled bearings. The Ladder, or "Sword," is sometimes made of wrought-iron, but usually of timber of suitable length and section, strengthened by a wrought-iron tension rod, with a cast-iron strut; the ends are fitted into cast-iron caps, the upper one forming the dead eye, and attached to the top Cam shaft and the bottom one carrying the bottom Cam. The Links are of wrought-iron with hardened steel bushes or eyes, and the bolts are case-hardened, the single links are riveted to the buckets, which are made of wrought-iron with steel lips, the working contents of each being about one cubic foot.

The barge for the Dredger described above was provided on the spot, and the machinery is driven by an ordinary horizontal Engine of about 10-horse power, speeded to give about 10 revolutions per minute to the Cam shaft, so that when the Ladder is up to its work, the buckets deliver 40 cubic yards per hour. In this case, a vertical Boiler with all the usual fittings, and a No. 1 Donkey pump, (see pp. 93, 113), is used; but in others, a multitubular Boiler has been preferred. The former is, however, the best where the water is brackish or liable to form deposit.

Including the Winch, Chains, Blocks, &c. for lifting the Ladder, and a wrought-iron Mud-shoot with tackle for carrying it, the total weight of the iron work for the Dredger to work at a depth of 10 feet, and discharge about 40 cubic yards per hour, was 10 tons, and the cost exclusive of erection was £200, and for the Engine and Boiler with all fittings, as described at page 77, £220, making a total cost of £420.*

This Dredger was driven by gear direct from the Engine shaft, and was therefore fitted with a friction clutch, which slips when under any undue strain, and prevents breakage and accidents; but in many cases the Cam shaft is driven by a strap, when the friction arrangement may be dispensed with. For use in crowded docks, rivers, &c. this machinery is adapted to work through the centre or over the stern of a barge, and for very variable depths of working, the telescopic Ladders described at page 104 may be used. The proportions can also be modified to do a larger or smaller amount of work than in the case described; but, to estimate the cost of dredging machinery, in every case the nature of the stuff to be dredged should be described, together with the maximum and minimum depth, and the amount of work to be done in a given time.

* The working expenses of one of these Dredgers, when Dredging 2,000 Cubic yards of hard sand per week, including 3 men and 1 boy, Coal @ 13/6 per ton, Oil, &c. and wear and tear at 10 per cent. per annum on the total cost, was £6 15/0 or ·82 pence per Cubic yard.



SCREW PROPELLER AND STEAM HOIST.

SCREW PROPELLER AND STEAM HOIST.

THESE Engines have been made for Goods and Passenger traffic, and they are particularly adapted for converting ordinary Boats or Barges to work by steam. By a slight modification the Engines can be made to drive twin screws, which give increased power or speed, and greater facility for turning than the single screw. There is the further advantage, that where timber boats are converted, the dead wood is not interfered with. A massive Iron Bedplate, of suitable form, carries the Boiler, Engines, Crank Shaft, and Thrust Bearings, so that very little expense is incurred in erecting, and it is done by ordinary workmen in the Colonies and elsewhere.

The engraving at p. 100 shows a Hoisting Apparatus worked by the Engine; for this purpose a clutch is provided for disconnecting the screw, and a sliding Pinion and Lever for throwing in the lifting motion.

When loading or discharging cargo, the Propeller usually lays on one side and the Lighters or Barges on the other side of the vessel, and a rope or chain is passed from the winding barrel over a Pulley suspended from a spar in the usual manner. The Propeller takes her complement of Barges in tow when they are loaded, and the lifting gear is available for landing cattle, lifting goods into Warehouses, &c. For discharging grain, minerals, &c. two ropes or chains are attached to opposite sides of the Barrel (as shown in the Steam Hoist at p. 22), so that an empty skip is lowered whilst the full one ascends.

The cost of the apparatus shown on p. 100, the Engine having two cylinders each 5½ in. diam. is about £250, and the total weight about 95 cwt. The sizes usually made are 6½ in. 7¼ in. and 8½ in. cylinders.

HOPPER BARGE WITH BAG AND SPOON,
FOR DOCKS, CANALS, &c.

THE arrangement of machinery illustrated at p. 100 has been used for a Hopper Barge, the Bag and Spoon being worked by the Steam Hoisting Gear and the Barge is moved by the Screw Propeller.

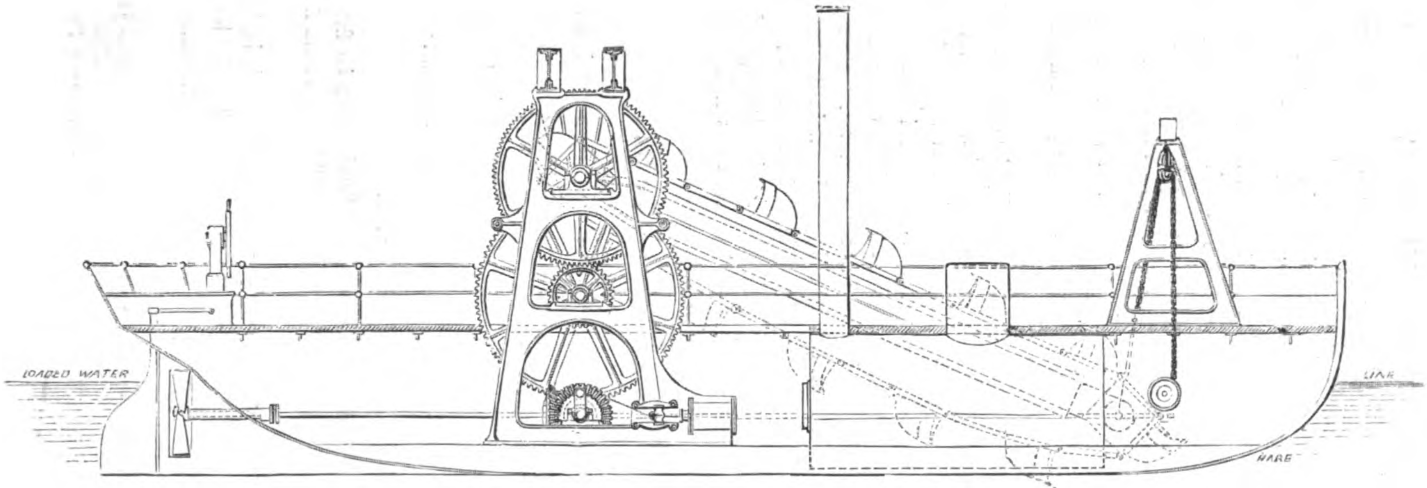
This facility for working and moving is found of great advantage in crowded Docks, &c. as well as for running out to the discharging ground; the work is done much quicker, and the expenses are considerably lower than for hand labour.*

FLOATING STEAM FIRE ENGINE.

IN addition to the propelling and hoisting machinery, the Engines can be fitted with double-action Lift and Force Pumps, to form a powerful floating steam fire engine propelled by steam.

The Boats can also be fitted with Tanks to convey fresh water to vessels laying at a distance from shore, and the pumps will force it through a flexible hose into the ship's tanks. Perhaps a more useful arrangement than this can scarcely be found for dock and river work.

* The working expenses of one of these Dredgers in Newport Docks, when dredging 140 yards in 12 hours, and discharging into the barge, including the wages of 5 hands, coal at 9/6 per ton, oil, &c., wear and tear at 10 per cent. per annum, is £1 11s. 6d., or 2¾d. per cubic yard.



FURNESS AND SLATER'S PATENT STEAM DREDGER WITH SCREW PROPELLER.

The arrangement illustrated and described at pp. 99 to 101, although adapted for a floating Dredger for *temporary* use, where the work is of a permanent character that shown in the above engraving is found more convenient.

As the work proceeds the length of the telescopic slide may be varied, and more or less Buckets put on, and the Bucket ladder may be placed at the most favourable angle to suit the nature of the work.

The Screw Shaft being thrown in or out of gear by a clutch, the Vessel is propelled by steam when desired; the Bucket ladders are raised and lowered by steam power, and the warping barrels are worked by steam.

These Dredgers being made from 3 (nominal) horse power to 20-horse power, and fitted with every appliance for saving manual labour, can be profitably used in canals, docks, &c. where the great size and cost of ordinary Dredgers would preclude their use.

All applications for price should be accompanied by details of the nature of the bottom, maximum depth of working, and the quantity of work to be done in a given time.

FURNESS AND SLATER'S PATENT STEAM EXCAVATING AND DREDGING MACHINE, OR FILTH HOIST.

THE engraving on next page represents this simple and efficient machine at work upon a staging, excavating under water, previous to sinking iron caissons or making a coffer dam of the ordinary construction for sea or river walls, docks, foundations of piers, &c. The characteristic features of this machine consist in its great simplicity, efficiency, and economy, and that it will excavate *under water*, sand, gravel, or clay, at infinitely less cost and time than by Bag and Spoon, Divers, or any other mode of working hitherto adopted; that the work may be carried on continuously in any state of the tide, and that when the coffer dam has been formed, the entire excavation of the dam may be accomplished by this machine without the great expense and loss of time usually incurred in pumping, tide work, &c. Some idea of the working expenses may be formed from the fact, that it usually excavates from 20 to 30 yards of stuff, lifting it from a depth of 40 feet, and discharging it into a barge, within the hour—the hands employed being, one engine driver and two labourers, and the consumption of fuel 40 lbs. of coal. For sea or river works the machine may be worked as an ordinary dredger fixed on a barge, or as an excavator travelling on staging, as may be most convenient, and after being used on the one, it may be readily transferred to the other. It is equally applicable for excavating cuttings for Railways, Sewers, or any similar work.

The Engine is attached to the main framing of the Machine, and the Boiler is placed in any convenient position. For working upon a staging, the whole is mounted on a truck which travels, and can be readily moved, either longitudinally or transversely, on a gantry similar to those used for an ordinary overhead travelling crane, and which can usually be made of sufficient span to take the whole of the excavation. The Jib, or ladder for carrying the buckets, is in the form of a telescope slide, and may be elongated as the work progresses, to any required length up to 40 or 50 feet. It is hung underneath the machine on a centre pin, consequently the Ladder and Buckets can easily be radiated while at work either to the right or left hand, and will reach very contracted places, or take a long face of work as required. In excavating clay or other intractable strata there has hitherto been considerable difficulty in discharging the buckets, but in this machine there is a self-acting arrangement, which entirely empties each bucket as it arrives over the Shoot, which conveys it into the barge or waggon beneath.

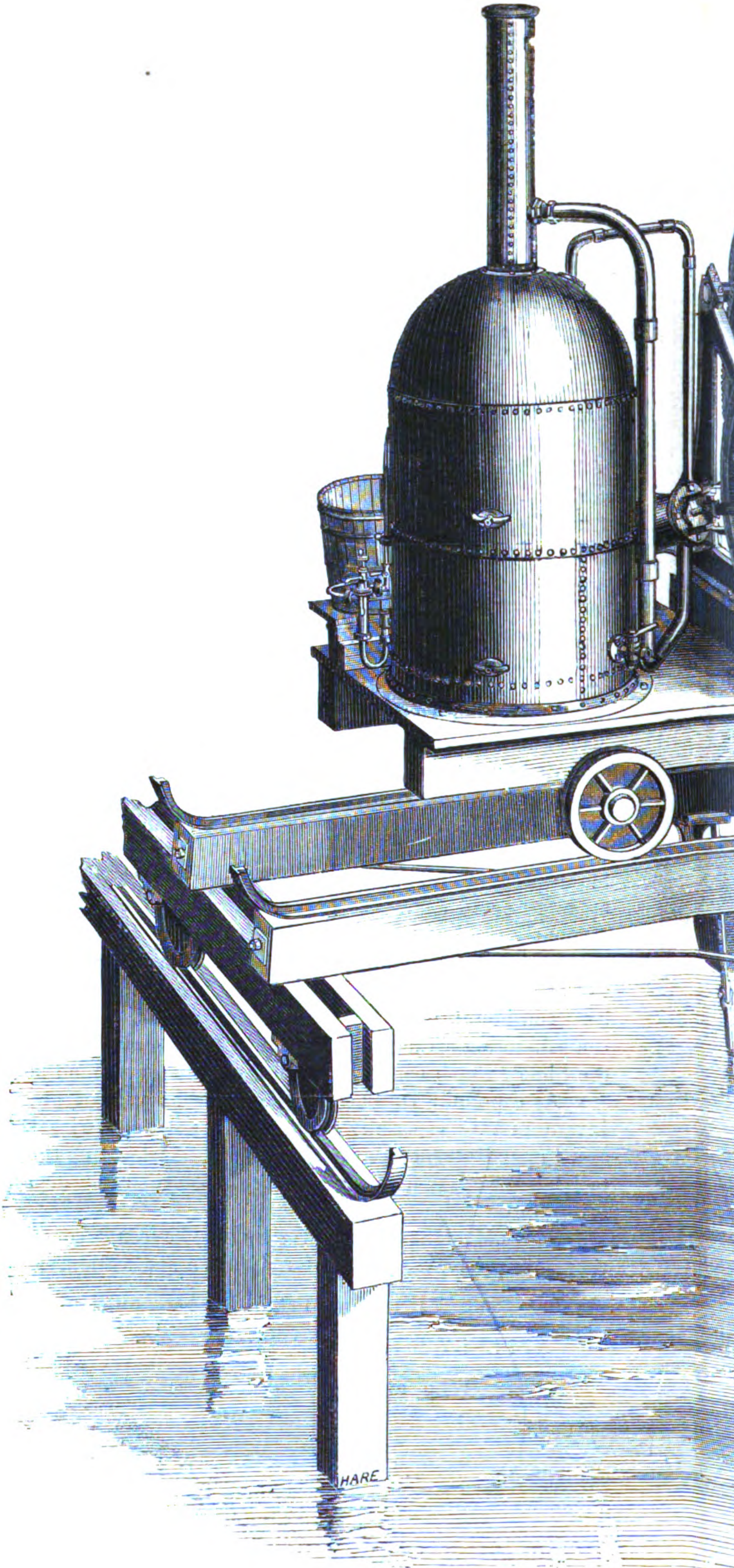
As the Main Drainage in Towns is at present greatly on the increase, the Inventors have especially adapted this machine (with some slight modification), as a FILTH HOIST, at Pumping Stations, for elevating the sewerage from Low Level to High Level, there being always a considerable deposit that Pumps will not bring up.

These Machines of various sizes may be seen in constant work, and all information as to prices, &c. will be furnished on application.

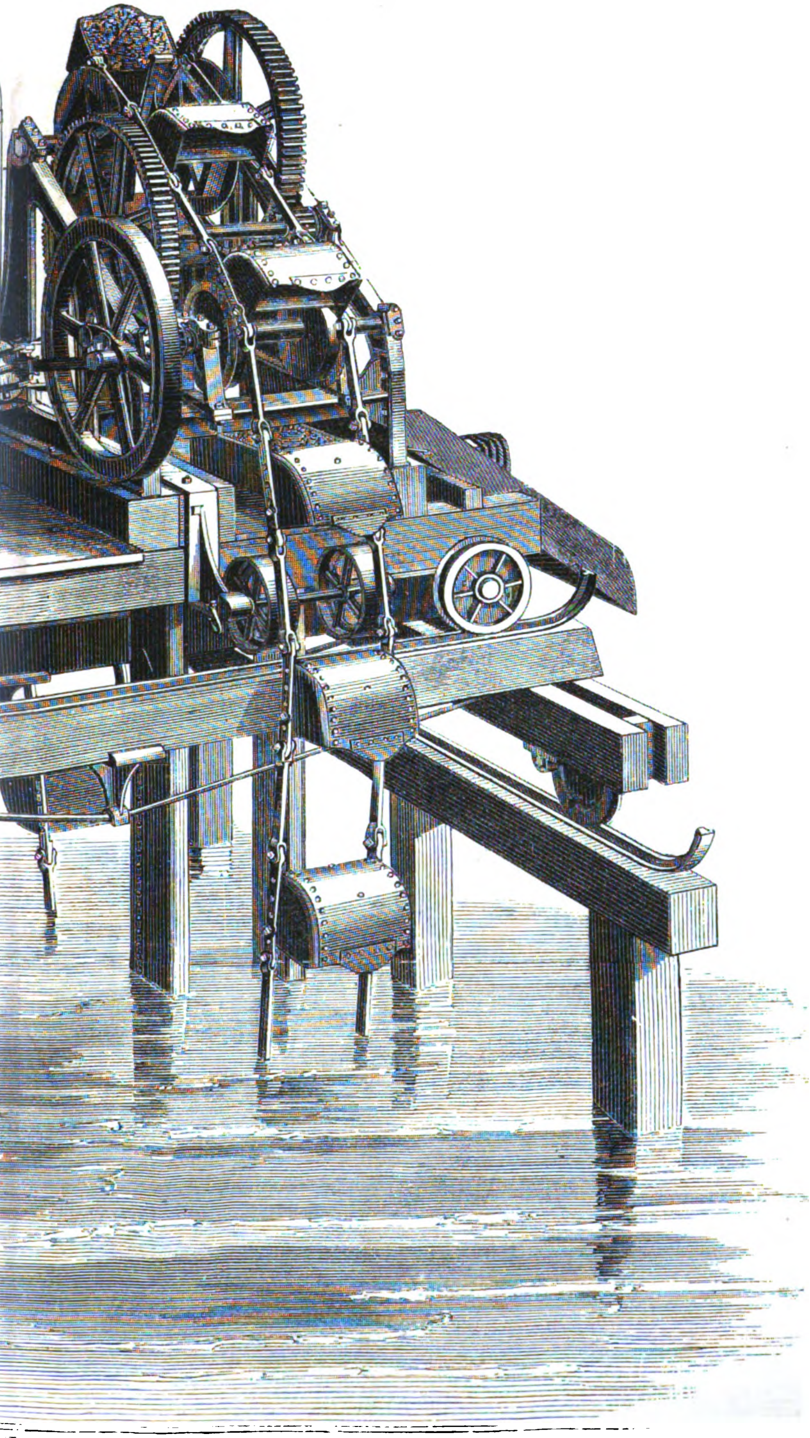
This Patent has been purchased by

APPLEBY BROTHERS, EMERSON STREET, SOUTHWARK, LONDON, S.E.

Who are the Sole Manufacturers of the Machines.



FURNESS AND SLATER'S PATENT STEAM EXCAV



CAVATING AND DREDGING MACHINE, OR FILTH HOIST.

STEAM AND HAND PUMPS,

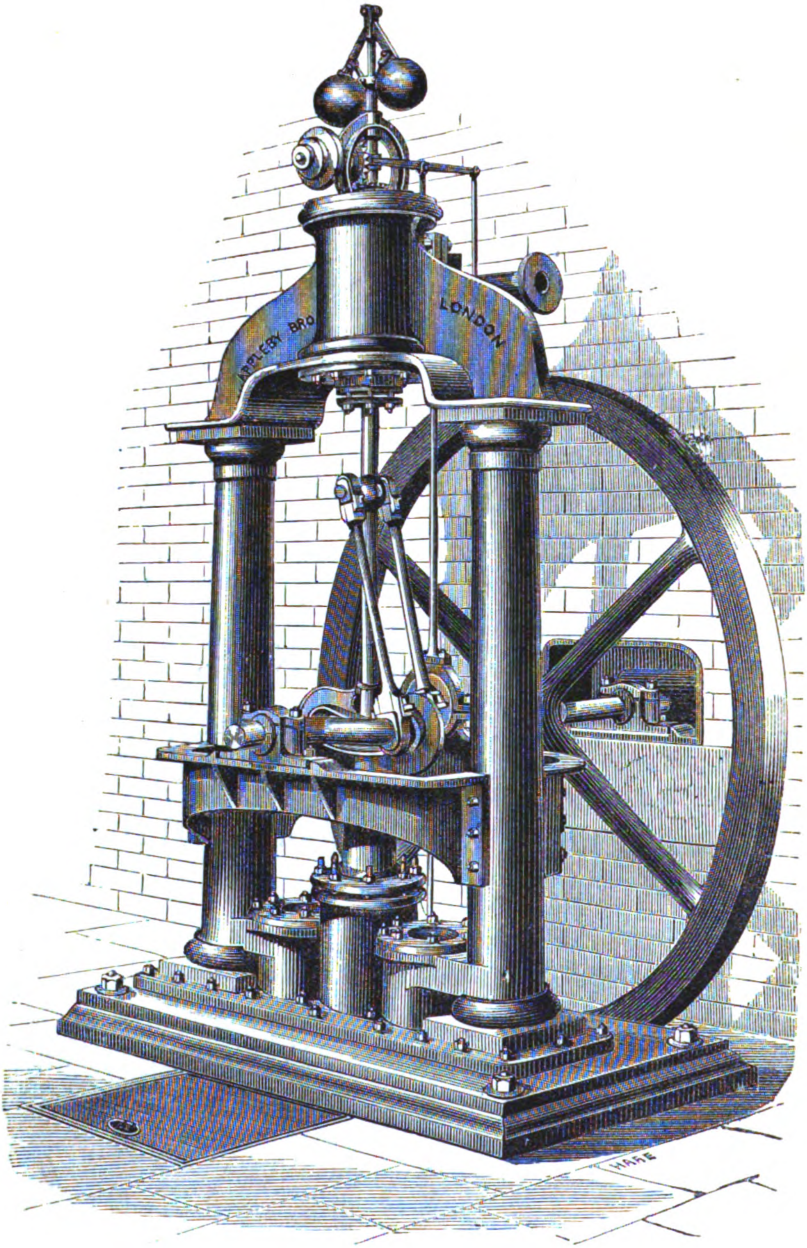
PUMPING MACHINERY,

HYDRAULIC RAMS,

FIRE ENGINES,

GAS AND WATER VALVES AND METERS,

PIPES, HOSE, AND GENERAL FITTINGS.



DIRECT ACTING PUMPING ENGINE.

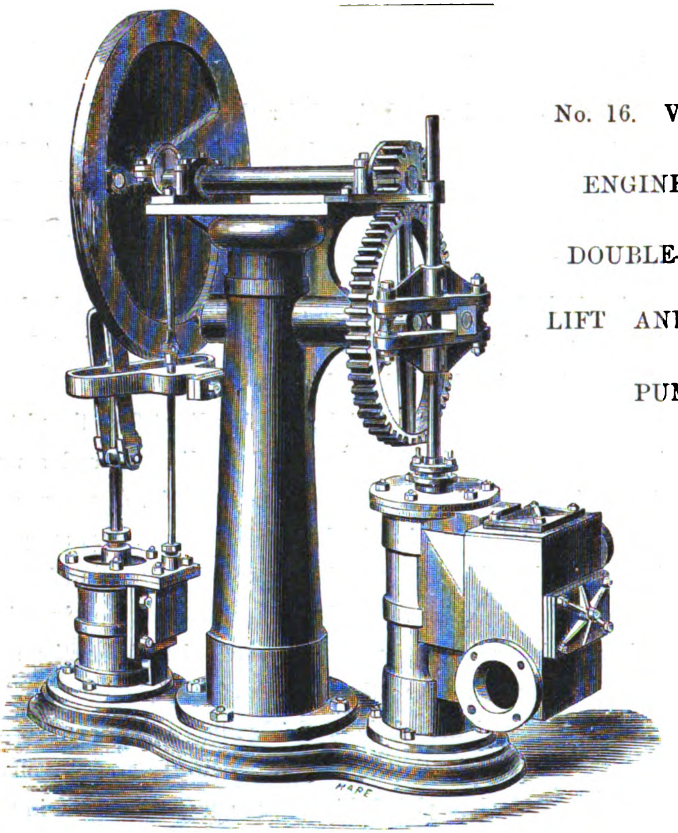
DIRECT ACTING PUMPING ENGINE.

THE Pumping Engine illustrated was designed for the water supply of large Terminal Stations and small towns and villages. It was originally constructed by the authors for the New South Wales Railway Company, and was calculated at 27 strokes per minute to raise 2,500 gallons per hour to a height of 300 ft. but the proportions can be modified to an almost indefinite extent.

When the water is within 25 ft. of the surface, the pump is fixed to the base plate as shown, but for use in deep wells it is placed at any convenient depth below, and the pump rod is carried down through the base plate.

The pump is on the Ram and Bucket principle, working direct from the piston rod, and the Engine under consideration has a bucket 7 in. diameter and a ram 5 in. diameter, with 13 in. stroke; the steam cylinder is 9½ in. diameter, and the same stroke as the pump. The suction, bucket, and delivery valves are gun-metal circular grids with india-rubber discs, and the two columns are used as air vessels for the suction and delivery valves. The bucket and working barrel portion of the pump are below the base plate, and covers are provided to the suction and delivery valves, for examination or repairs; the crank is of wrought iron, as well as the double connecting rods, and the whole of the bearings and glands are of gun-metal; the eccentric which works the slide valve also works a small hollow plunger feed pump, placed on the base plate behind the pump (and not seen in the engraving); the governors are on the top cover of the steam cylinder, and are fitted with cone gut pulleys for driving at variable speeds, throttle valve, and levers. A heavy fly-wheel is keyed on to the projecting end of the crank shaft, and the outer end is provided with a wall box and pillow block, or a short standard to carry pillow block is supplied when the Engine is not fixed against a wall. The whole is mounted on a strong cast-iron base plate, in which the delivery passages are cast, a flanged connection being made with the pipes on the underside of the plate. The steam was taken from a 6 HP. Cornish Boiler 10 ft. long × 3½ ft. diameter, with all fittings as described at page 92, and the cost of the whole, including the boiler and all connections ready for erecting is, £200.

Where the supply of water required is less than that indicated above, the arrangement shown at page 111 will be found useful and economical, and the pumps No. 6 to No. 9 may be used.



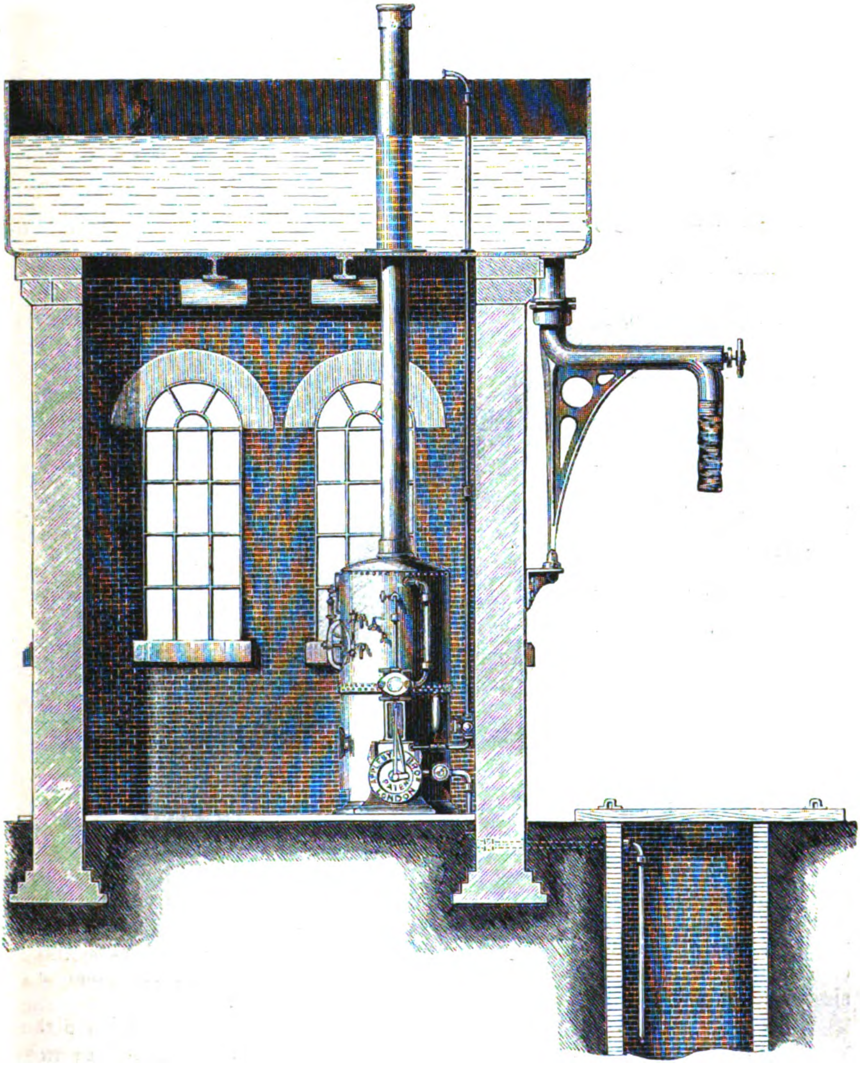
No. 16. VERTICAL ENGINE AND DOUBLE-ACTING LIFT AND FORCE PUMP.

When a large supply of water is required in situations where power cannot be easily obtained from an existing Engine, or where a large Engine is only running the usual working hours, whilst the water supply must be continuous, this compact arrangement may be usefully employed. It has been used for Well Sinking, as well as for the water supply of Paper Mills, Tanneries, Breweries, Railway Stations, and similar establishments. The steam is brought from a Boiler in any convenient position, to the Steam Cylinder which is at one end of the base plate, the Pump being secured to the other end; and where the Pump is used as a Fire Engine, or Boiler Feed Pump, or for forcing to a great height, the central column forms a capacious air vessel as well as a bearing for the Crank Shaft. The Crank Plate is made extra large, and is balanced to dispense with a Fly-Wheel, and the Engine and Pump are got up in the best style. In order to make the Engine available for other purposes than pumping, a Pulley is keyed on the Crank Shaft for transmitting the power by a leather band. The arrangement shown is for Wells not exceeding 20 to 25 feet deep, but where the water is a greater depth from the surface the Pump is fixed in the Well, and the Pump Rod passes through the Base Plate.

For details of the internal construction

Diameter of Pump.	Stroke.	Price of Engine and Pump as shown.	Approx. Galls. per hour at 40 strokes per min
Inches.	Inches.	£	Galls.
3	9	65	1,000
3	12	70	1,350
4	9	75	1,800
4	12	80	2,500
6	12	85	5,250
8	14	100	11,500

of this Pump, see description of Pump No. 14, at page 1[illegible]2.



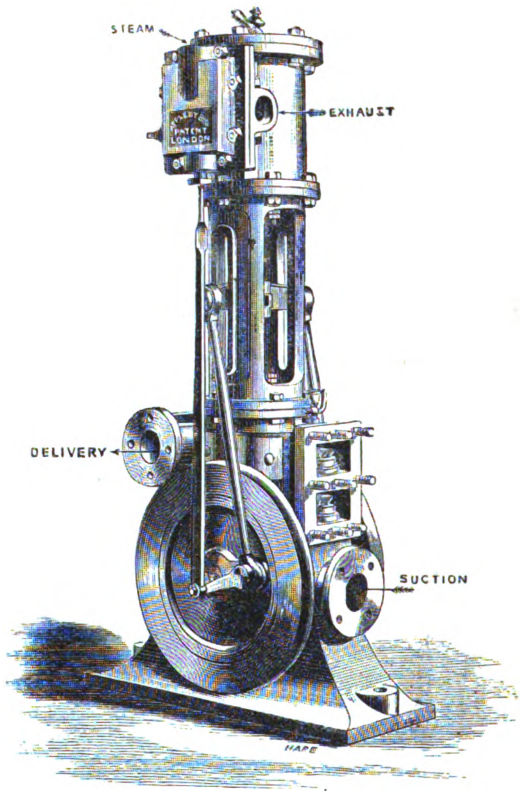
PUMPING ENGINE, TANK HOUSE, AND WATER CRANE.

A VERTICAL boiler supplies steam to a double-acting steam pump of the kind illustrated and described at p. 112; the tank forms the roof of the building, and the chimney passes through an outer pipe, the warmth of which prevents the water freezing during cold weather. The water crane is carried on a strong cast-iron bracket at the bottom, fitted with a gun-metal bush and a gun-metal gland at the top. The branch is supplied with a leather pipe, stop valve, &c.

The cost of the machinery necessarily varies with the proportions required, but a steam pump to draw from a well not exceeding 20 feet deep, and to force 2,500 gallons per hour into the tank, with boiler and all mountings, as specified at page 93, and a water crane as described above of 6 feet radius, is about £120.

No brickwork or foundations are required beyond the ordinary floor and walls of the building, and the arrangement is economical in cost and in working expenses.

The prices INCLUDE
the
Gun-Metal Fittings,
and in the
smaller sizes (to No. 4)
An Air Vessel
as shown in the illustrations, which are charged as *extras by other makers;* if they are omitted a corresponding reduction will be made.



DOUBLE-ACTING PUMP ON BASE PLATE. (*Fig.* 3.)

In the larger sizes (No. 5 and upwards), it is found by experience that a side strain is produced if the Engines are fitted with a single fly-wheel and connecting-rod; these sizes are therefore made with double cross-heads working in vertical guides, two connecting-rods and two fly-wheels, and the whole is mounted on a base plate suitable for bolting down, as shown in the engraving, or may be made for attaching to a wall same as the smaller sizes, except No. 9, which is only made *with the base plate.*

The Pumps Nos. 5, 6, 7, 8, and 9, are frequently fitted with air-vessels on the suction and delivery pipes, and are used as Fire-engines in factories, public buildings, on board ship, &c.

Prices for Pumps of larger sizes will be given on application.

Nos.	5	6	7	8	9
Diameter of Ram	2¾ in.	3 in.	3¼ in.	3½ in.	4 in.
*Gallons per hour	1200	1500	2100	2500	3800
Approximate H. P. of Boiler .	80	95	130	150	230
Pump on base plate (fig. 3) price	£27	£32	£38	£43	£50

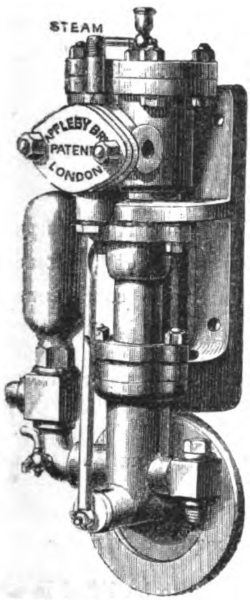
If fitted with LARGE AIR VESSELS, 30/0 to 40/0 extra.

Ditto, and with DOUBLE BRANCH PIPE, one to connect to boiler, and the other with gun-metal cap and hose screw for use as a fire-engine, £3 10*s.* extra.

APPLEBY'S PATENT

DONKEY ENGINES FOR FEEDING PORTABLE, LOCOMOTIVE, MARINE, OR STATIONARY BOILERS, SUPPLYING TANKS, &c.

Selected by the Commission of the Paris Exhibition, 1867, *for use in the Boiler House of the British Section, and awarded the "Médaille d'Honneur."*

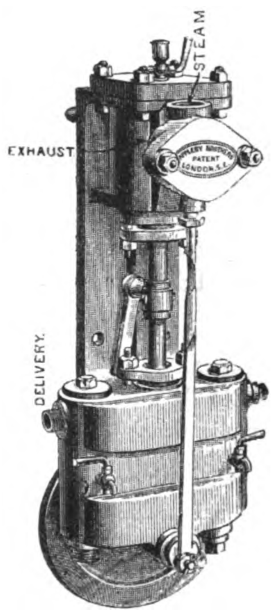


SINGLE-ACTING PUMP.
(*Fig.* 1.)

THESE Pumps are cheap, durable, and so simple that an unskilled workman can use them. The working parts and valves are of hard gun-metal and hardened cast-steel. They may be fixed vertically or horizontally, and used for FEEDING BOILERS, as Fire-engines, for supplying tanks, or for lifting and forcing hot liquors. Every Pump is tested in steam (with hot water) before being sent out.

As many of the accidents to Steam Engines and Boilers are directly traceable to a temporary derangement of the feed-pumps, it is most important that there should be two separate means of feeding every Boiler, and in many countries this is compulsory by law. These Pumps can be used for feeding the Boiler when the Engine is standing, which is frequently a great convenience, and the cost is so small as to be scarcely worth consideration in comparison with the advantages to be derived.

As some chemicals are deteriorated by contact with Iron or Brass, these Pumps are made of either metal required, special quotations for which will be given on application.



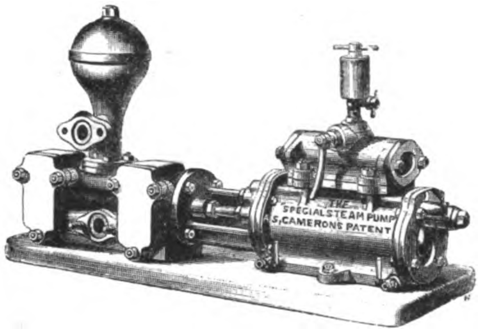
DOUBLE-ACTING PUMP.
(*Fig.* 2.)

* The subjoined quantities are given for the Single-acting Pumps worked at 200 strokes per minute, and the Double-acting worked at the same speed would give double those quantities; it is, however, advisable to have the Pumps larger than is theoretically required, and to work at a slower speed; but, being direct-acting, there is no appreciable wear and tear when working at high speeds.

Nos.	1	2	3	4	5	6	7	8
Diameter of Ram	1½ in.	2 in.	2¼ in.	2½ in.	2¾ in.	3 in.	3¼ in.	3½ in.
* Gallons per hour	·230	400	680	850	1200	1500	2100	2500
Approximate H.P. of Boiler	15	25	40	50	80	95	130	150
Single-Acting. Fig. 1. Price.	£10 5	£12 10	£15	£18				
Double-Acting. Fig. 2. Price.	£11 10	£14	£17	£20	£24	£28	£33	£38

Comparative Cost of GIFFARD'S INJECTOR *working at a pressure of* 40 *to* 50 *lbs. per square inch.*

Iron Case . .	£13 10	£16 10	£22 10	£25 10	£31 10	£34 10	£41 10	£45 10
Brass Case . .	£19 0	£23 0	£32 0	£36 0	£45 0	£50 0	£60 0	£65 0



CAMERON'S PATENT STEAM PUMP.

THIS Pump is adapted for all ordinary purposes for which steam driven pumps are used; it is economical in first cost, occupies very little space, and the wear and tear is reduced to a minimum, because there is absolutely no extraneous gear.

No fly-wheel, crank, governors, connecting rod, eccentric, springs, or other complications.

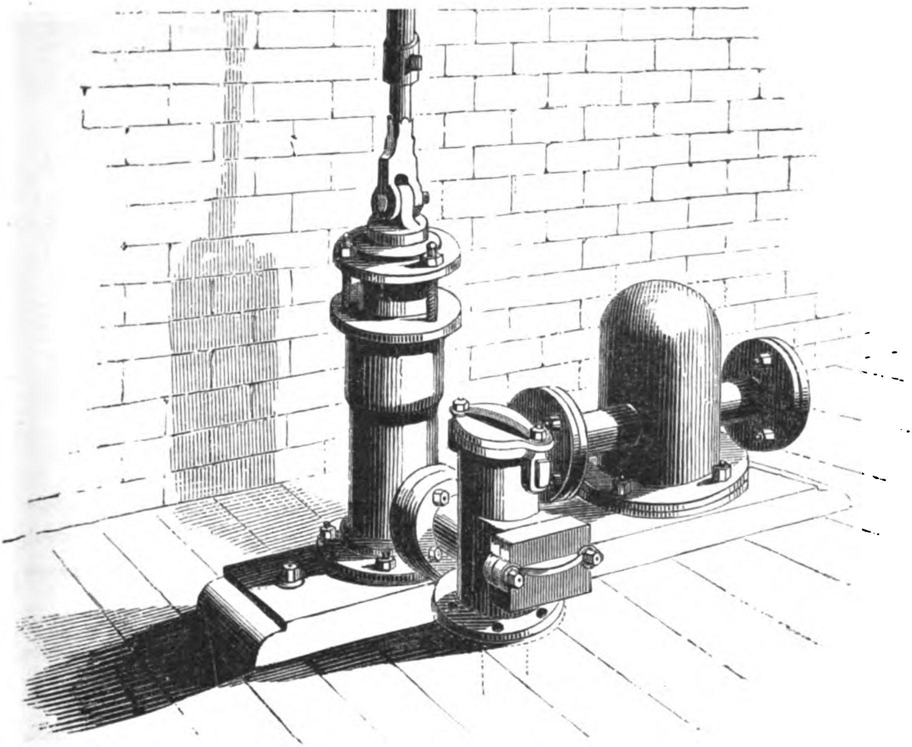
All double-acting, and may be worked at any speed, varying from one to a hundred strokes per minute.

In case of special quotations, the following particulars are required, viz.:

Pressure of steam in boiler; the number of gallons required to be lifted in a given time; and the height of lift from the level of the water to the point of delivery.

In ordering, state the purpose for which the Pump is required, to ensure suitable valves being sent.

DIAM. STEAM CYLINDER	2¼in.	3in.	4in.	6in.	6in.	7in.	8in.	10in.	12in.	14in.
DIAM. WATER CYLINDER	1¼in.	1⅝in.	2in.	3in.	4in.	5in.	6in.	7in.	8in.	10in.
GALLONS PER HOUR.......	475	680	1220	2750	4900	7650	11,000	15,000	19,580	30,500
APPROX. H.P. BOILER....	25	50	68	134	250	—	—	—	—	—
PRICE.........................	£10	£15	£20	£30	£40	£50	£55	£70	—	—



No. 11. PLUNGER PUMP FOR STEAM POWER, VERTICAL (OR HORIZONTAL).

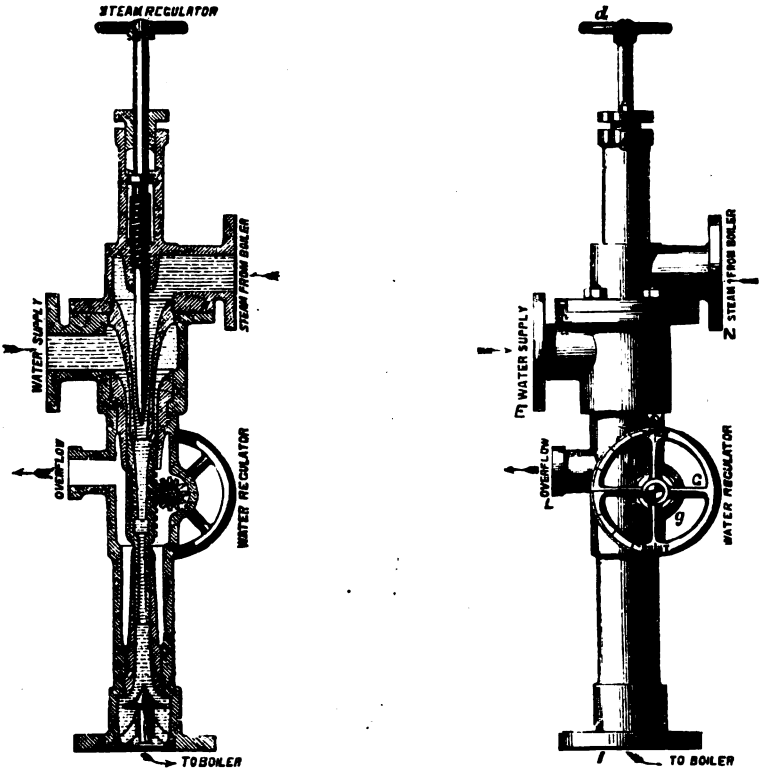
With cast-iron bored working barrel and solid cast-iron plunger, working through a gland and stuffing box, gun-metal valves (or Appleby's patent conical valves), sliding connecting rod as shown, which is made to disconnect by simply driving out the cotter. Doors are provided for access to all the valves. These pumps are suitable for heavy lifts, manufacturing purposes, gas works, &c. &c., and are usually worked by cranks or eccentrics on a line of shafting, or by a disc plate if at the end of the shaft.

Diam. of Plunger.	Iron Plunger and Barrel and Gland.	Gun Metal Plunger and Gland, Iron Barrel.	Iron Air Vessel. Extra.
2½ in.	£4 4 0	£5 5 0	£1 0 0
3 „	5 10 0	7 0 0	1 5 0
3½ „	7 10 0	9 10 0	1 10 0
4 „	11 10 0	14 10 0	1 18 6
4½ „	14 10 0	17 10 0	2 5 0
5 „	18 0 0	21 10 0	2 5 0

Strap Head Connecting Rod Ends, 30/0 to 50/0 each.

Eccentrics, Disc or Crank Plates, see page 179.

Bright Shafting, Brackets, Plummer Blocks, &c.



GIFFARD'S PATENT SELF-ACTING WATER INJECTOR FOR FEEDING BOILERS, &c.

WITH ROBINSON AND GRESHAM'S PATENTED IMPROVEMENTS COMBINED.

The following Table shows the Sizes and Prices of Injectors of two kinds, viz.: of brass throughout, or with cast-iron casing and brass cones; also the number of gallons per hour they are capable of supplying to a Boiler, according to the pressure per square inch of steam employed.

In asking for quotations of Injectors, it is necessary to state the dimensions and description of the boiler or boilers for which they are intended, and the average working pressure; also which sort of Injector is required, *whether* of *brass throughout* or with *cast-iron casing.*

Instructions for fixing and working will be supplied with each Injector. Prices see next page.

Giffard's Injector with Seller's Improvements are sometimes preferred; the prices are—

No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Brass Case	£11	15	18	23	28	33	38	43	48	54	61	67	74	80	86	93
Cast-Iron Case	£9	11	14	17	21	25	28	32	36	41	45	50	55	60	65	71

In all cases the carriage from the Works is charged extra.

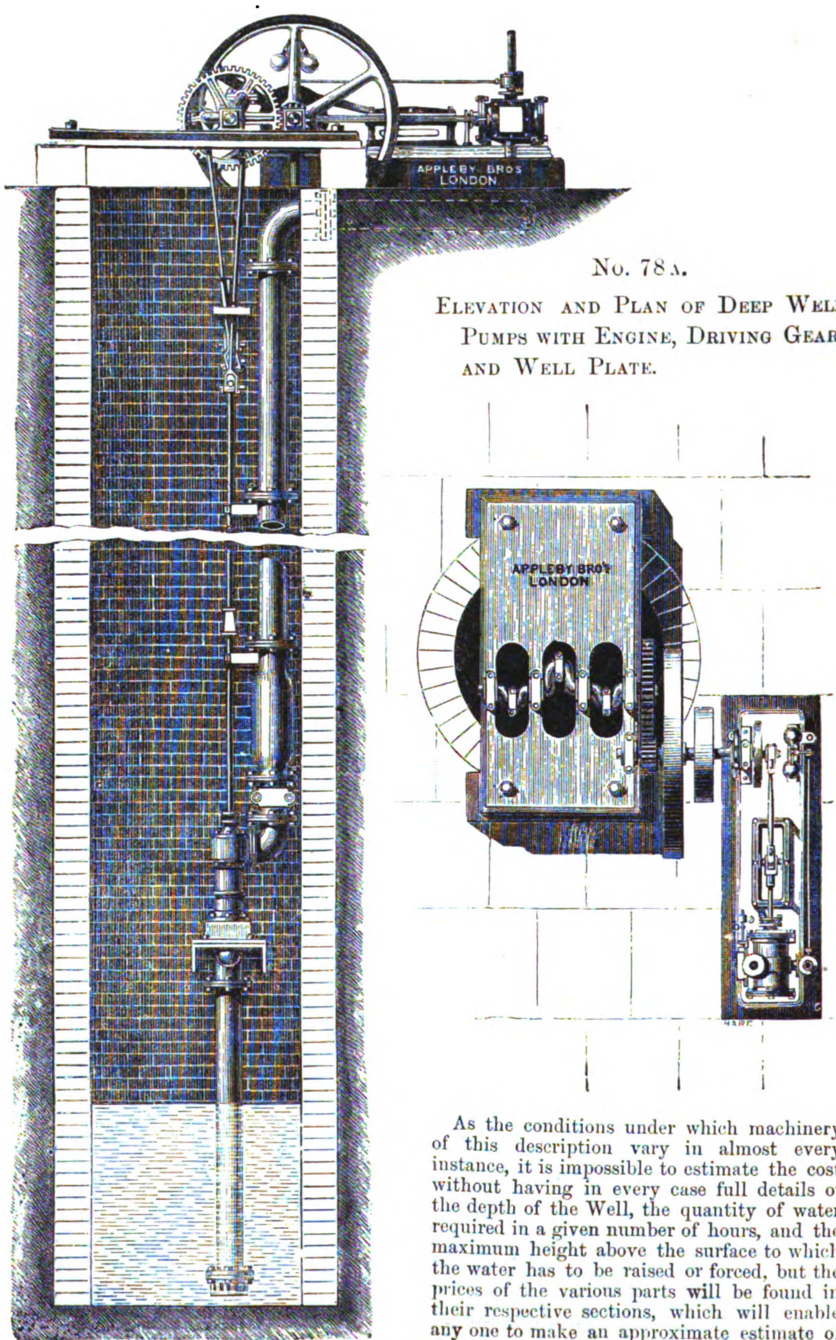
GIFFARD'S PATENT SELF-ACTING WATER INJECTOR FOR FEEDING BOILERS, &c.

WITH ROBINSON AND GRESHAM'S PATENTED IMPROVEMENTS COMBINED.

Table of Sizes and Prices.

SIZE of Injector in Milli-metres.	PRICE at the Works. *Brass.*	PIPES. internal diam.	10 lbs.	20 lbs.	30 lbs.	40 lbs.	50 lbs.	60 lbs.	70 lbs.	80 lbs.	90 lbs.	100 lbs.	110 lbs.	120 lbs.	130 lbs.	140 lbs.	SIZE of Injector in Milli-metres.	PRICE at the Works. *Cast Iron casing.*	
No.	£	In.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	Gals.	No.	£	s.
2	9	9/16	20	28	35	40	47	49	53	57	60	64	67	70	73	75	2	6	10
3	12	9/16	45	64	78	90	101	111	120	128	136	143	150	157	163	169	3	8	10
4	15	1	80	114	139	161	180	197	213	228	241	254	267	279	290	301	4	10	10
5	19	1	126	178	218	251	281	308	333	356	377	397	418	436	453	470	5	13	10
6	23	1 3/8	181	256	314	362	405	444	479	512	543	572	600	627	653	677	6	16	10
7	27	1 3/8	246	348	427	493	551	604	652	697	739	779	817	854	888	922	7	19	10
8	32	1 3/4	322	455	557	643	719	788	850	910	965	1018	1068	1115	1160	1204	8	22	10
9	36	1 3/4	407	576	706	814	911	998	1078	1152	1222	1288	1351	1411	1468	1524	9	25	10
10	40	2	503	711	871	1005	1124	1232	1331	1422	1549	1590	1669	1742	1813	1882	10	28	10
11	45	2	608	860	1054	1216	1360	1491	1610	1720	1825	1924	2018	2107	2194	2277	11	31	10
12	50	2	724	1024	1254	1448	1619	1774	1916	2048	2172	2289	2402	2509	2611	2710	12	34	10
13	55	2 3/8	849	1201	1472	1699	1882	2082	2248	2404	2550	2687	2819	2944	3064	3180	13	37	10
14	60	2 3/8	985	1393	1707	1970	2203	2415	2609	2788	2957	3116	3270	3414	3553	3688	14	41	10
15	65	2 3/8	1131	1599	1960	2262	2529	2772	2994	3200	3394	3577	3753	3920	4079	4234	15	45	10
16	70	2 5/8	1287	1820	2230	2574	2878	3154	3406	3641	3862	4070	4270	4460	4641	4818	16	49	10
17	75	2 5/8	1454	2054	2517	2905	3249	3560	3845	4111	4360	4595	4821	4865	5239	5439	17	53	10
18	80	2 5/8	1629	2303	2822	3257	3642	3992	4311	4608	4888	5151	5405	5644	5874	6107	18	56	10
19	85	2 5/8	1815	2566	3144	3629	4058	4448	4803	5135	5446	5740	6022	6289	6544	6794	19	59	10
20	90	3	2011	2843	3484	4021	4497	4928	5322	5688	6034	6360	6673	6968	7249	7528	20	62	10
21	95	3	2173	3135	3843	4433	4957	5433	5867	6248	6709	7008	7334	7633	7878	8149	21	65	10
22	100	3	2385	3440	4215	4865	5441	5962	6439	6857	7364	7692	8049	8377	8646	8944	22	69	10
23	105	3	2606	3747	4594	5311	5930	6517	7006	7494	7951	8407	8798	9189	9450	9775	23	73	10
		3 1/2	2836	4080	5002	5783	6457	7096	7628	8160	8657	9154	9580	10005	10289	10644	24	77	10
		3 1/2	3080	4427	5428	6275	7007	7700	8277	8855	9394	9932	10395	10857	11165	11550	25	81	10
		3 1/2	3373	4789	5871	6788	7579	8328	8953	9578	10161	10744	11243	11743	12243	12701	26	85	10

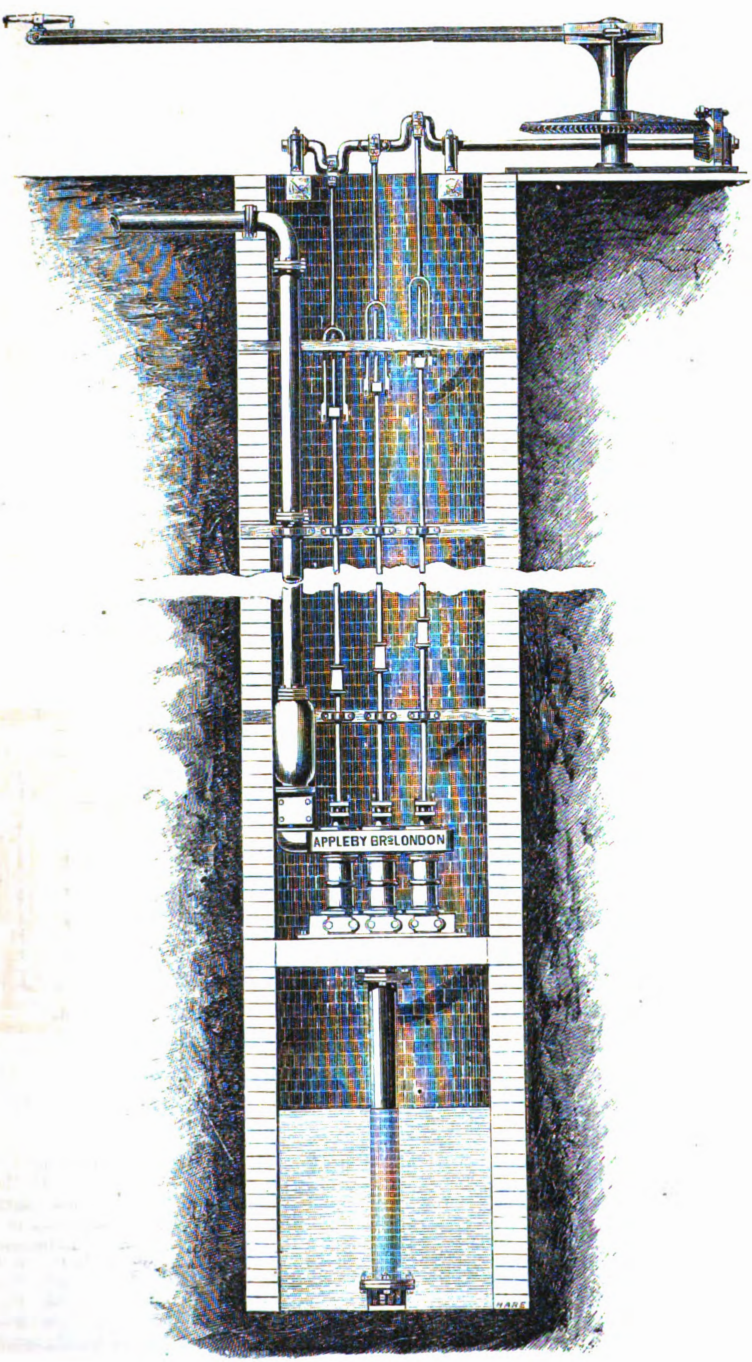
To find the size of Injector for Stationary Boilers, multiply the nominal H.P. by 12.5; then, in the column headed by the working pressure, find the number of gallons so obtained, or not finding the exact number, take that next higher, and the Injector opposite this number is the one required. For Marine Boilers, instead of 12.5, multiply by 18.5 (giving thereby the requisite allowance for blowing off the brine, &c.), and proceed as above.



No. 78 A.

Elevation and Plan of Deep Well Pumps with Engine, Driving Gear, and Well Plate.

As the conditions under which machinery of this description vary in almost every instance, it is impossible to estimate the cost without having in every case full details of the depth of the Well, the quantity of water required in a given number of hours, and the maximum height above the surface to which the water has to be raised or forced, but the prices of the various parts will be found in their respective sections, which will enable any one to make an approximate estimate of the cost of such work.



(No. 78.) TREBLE BARREL PUMPS WITH HORSE OR BULLOCK GEAR.

No. 78. DEEP WELL PUMPS, FOR HORSE OR BULLOCK POWER,

With Strong single speed pillar Horse Gear on Iron Base Plate, fitted with swivel yoke for one horse, bevel wheel and pinion, wrought-iron crank and suitable bearings, slings and guides, pump rods, rising main pipe up to ground line, with all bolts, nuts, and packings; the pumps are made extra strong, with full water-ways, doors to give access to the buckets and valves, brass valves (or Appleby's patent oscillating conical valves if preferred), gun-metal stuffing boxes, suction pipe, and strainer for bottom of well, all complete for 30 ft. deep, as shown in the engraving; exclusive of well stages or guides which are usually formed of timber.

DOUBLE PUMPS.

Bore of Working Barrel.	Price, complete for Well 30 ft. deep, DOUBLE BRASS PUMPS.			Extra per foot if exceeding 30 ft. deep.		Approximate Gallons per hour.	
						At 20 strokes per minute.	At 30 strokes per minute.
Inch.	£	*s.*	*d.*	*s.*	*d.*		
3	63	0	0	4	0	500	700
3½	66	0	0	4	3	650	900
4	69	0	0	5	0	900	1,200
5	87	0	0	7	0	1,500	2,000

For Gearing to increase the speed of working, £5 extra.

TREBLE PUMPS.

Bore of Working Barrel.	Price, complete for Well 30 ft. deep, TREBLE BRASS PUMPS.			Extra per foot if exceeding 30 ft. deep.		Approximate Gallons per hour.	
						at 20 strokes per minute.	at 30 strokes per minute.
Inch.	£	*s.*	*d.*	*s.*	*d.*		
3	76	0	0	5	0	760	980
3½	80	0	0	5	3	980	1,350
4	93	0	0	6	0	1,350	1,900
5	112	0	0	7	3	2,100	2,900

For Gearing to increase the speed of working, £5 10*s.* extra.

The internal diameter of the suction and rising main pipes for low lifts should not be less than two-thirds the diameter of the pump; and in all *deep wells* it is recommended that the pipes should be the *same diameter* as the barrel,—this will ensure much greater ease in working.

(No. 79.) STRONG SINGLE SPEED PILLAR HORSE OR BULLOCK GEAR,

Same as shown at p. 119, mounted on iron base plate, with one pole and swivel yoke, bevel wheel and pinion, and suitable bearings, strap-head connecting rods, slings and guides ready for welding to the pump rods, but EXCLUSIVE of PUMP.

	Strong Gear.			Lighter Gear.		
	£	*s.*	*d.*	£	*s.*	*d.*
Suitable for Single Barrel Pump with a single crank or arm .	34	0	0	29	0	0
For Double ditto, with wrought-iron double Crank	40	0	0	35	0	0
For Treble ditto, with ditto treble ditto. . . .	48	0	0	43	0	0

For Second Motion Shaft and pair of spur wheels to increase the speed, £5 to £6, extra.
Each Pole with Swivel Yoke, £1 15*s.* 0*d.*

(No. 80.) DOUBLE-ACTION PUMPS FOR DEEP WELLS,

With improved Pillar Horse Gear mounted on Iron Base Plate.

THIS DOUBLE-ACTION PUMP, as No. 14 on p. 122, delivers in a continuous stream, both at the up and down stroke of the piston, and is equal in capacity to an ordinary double-barrel pump, but requires only one set of pump rods, and a single throw crank or disc-plate; the HORSE GEAR is strong and self-contained, with single speed, and 1 pole and yoke (but with a cap suitable for 3 horses or bullocks if required). The prices are for the Pumps complete, with connecting rod, slings, suction pipe, and delivery pipe to ground line, all bolts, nuts, and packings for the joints, complete and ready for fixing in a well 30 feet deep.

Bore of pump.	Stroke.	Gallons per hour approximately.		Price complete for 30 feet deep.		Extra per ft. beyond 30 feet.
		At 20 strokes per minute.	At 30 strokes per minute.	With Iron barrel.	Brass lined barrel.	
Inch.				£ s. d.	£ s. d.	
3	9	500	750	42 10 0	44 0 0	3/6
3	12	650	975	43 0 0	44 10 0	3/6
4	10	1,000	1,500	45 0 0	47 5 0	4/0
4	12	1,200	1,800	46 0 0	48 10 0	4/0
6	10	2,200	3,300	64 0 0	67 0 0	5/0
6	12	2,650	3,975	65 10 0	68 10 0	5/0
8	12	4,650	6,975	73 0 0	78 0 0	6/6
8	14	5,400	8,100	75 0 0	80 0 0	6/6

For wells exceeding 30 feet in depth, and for the larger sizes of pumps, horse gears of extra strength are usually supplied, with an extra countershaft, bearings, and wheels to increase the power, at an additional cost of £5 to £7 10*s.*

This additional gearing may be added to pumps of any size, and may be arranged to *increase the speed* and number of strokes per minute, and consequently the quantity of water delivered.

THE PORTABLE DOUBLE-ACTION IRRIGATOR OR FORCE PUMP.

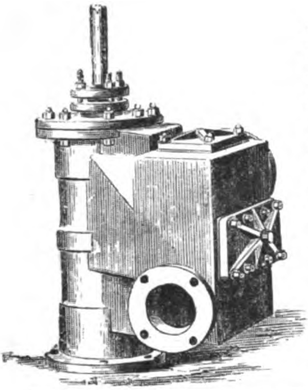
A STRONG timber frame carries a horse gear and a double-action Force Pump, similar to No. 14, but placed horizontally, and working with a wrought-iron crank or disc plate direct from the horse wheel; a large air vessel is placed on the delivery branch, which equalizes the flow and relieves the pump. It can therefore be put down and set to work as soon as the suction and delivery hose, or pipes, are attached, and does not require to be bolted or fastened down. This is a most convenient kind of pump for irrigation, or for the distribution of liquid manure, and is equally efficient as a Portable Fire Engine.

The duty may be calculated at about the same as stated for No. 80 above.

Diameter of Pump Cylinder	3	4	6	8	in.
Pump as described above, with Iron Barrel	£35	£38	£50	£65	each.
Ditto, with Brass internal Barrel	£37	£41	£54	£70	,,
If mounted on 4 wheels for transport, and a pair of shafts . . . . extra	£10	£10	£15	£15	,,
Pole, hook, and whippletree, for each horse . extra .	30*s.*	30*s.*	30*s.*	30*s.*	,,

Prices of Suction and Delivery Hose, Branch Pipes, Hose Union, &c. *see* pp. 178, 180.

No. 14.—DOUBLE ACTION LIFT AND FORCE PUMPS.



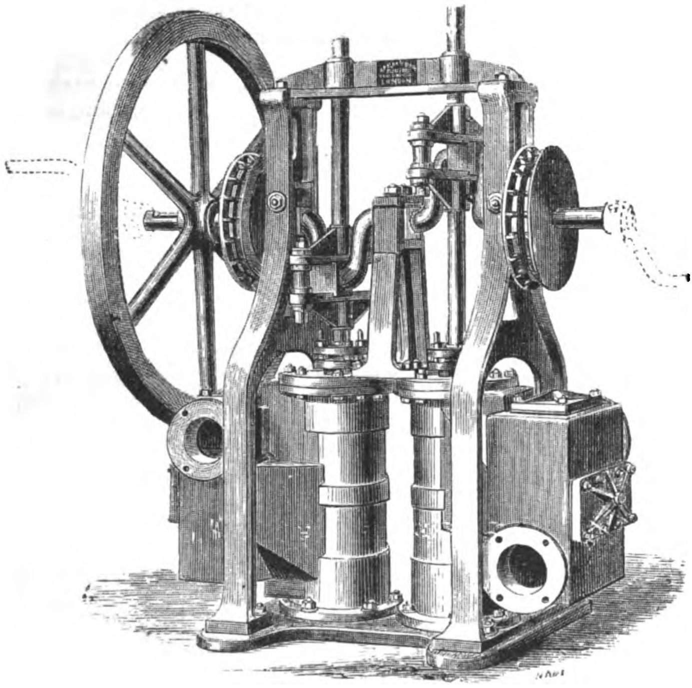
THESE Pumps are exceedingly compact, strong, simple in action, and all the working parts are easily accessible. The pumps are fitted with gridiron valves and india-rubber discs arranged so that by removing one bolt the valve can be taken out and replaced; the piston packings are double cupped India-rubber specially prepared for the purpose, so that the pumps may be used for any chemicals which do not affect that substance, and their working is rarely interrupted by great changes in temperature, or when they remain unused for a long period in hot or cold climates.

Being on the *double action* principle, viz.—to raise water at both the up stroke and down stroke, one of these pumps is equal in capacity to two single action pumps of the same diameter, whilst only one set of gear is required to work it. They are adapted to work by hand, or they are fitted to portable and ships' engines and cranes, and being proportioned throughout for lifting and forcing, they are available for all ordinary purposes, whilst in an emergency they may be used as FIRE ENGINES, or for SHIPS' PUMPS of the most powerful description.

Diameter of Pump.	Stroke.	No. 14 Pump. Iron Barrel. Bored.	No. 14 Pump. Brass Lined Barrel. Bored.	If with Standards, Slings, and Guides, extra.	Approx. Gallons per hour at 40 Strokes per min.
Inches.	Inches.	£ s. d.	£ s. d.	£ s. d.	Gallons.
3	9	11 0 0	12 10 0	2 2 0	1,000
3	12	11 10 0	14 0 0	2 5 0	1,300
4	9	12 0 0	14 10 0	2 10 0	1,800
4	12	13 5 0	16 0 0	2 12 6	2,500
6	12	21 10 0	25 0 0	3 10 0	5,200
8	14	30 0 0	34 0 0	4 5 0	11,500

IMPROVED DOUBLE ACTION PUMPS, FOR HAND OR STEAM POWER.

No. 17.



THE construction of these pumps is fully described at No. 14. This illustration shows a powerful set of pumps with 2 barrels, each 8 inches diameter, suitable for ships' decks or any other purpose, and will deliver about 23,000 gallons per hour, but the arrangement may be modified to suit almost any special circumstances which may arise. Fitted as shown, price, with brass lined Barrels, &c. . £85.

No. 18. DOUBLE ACTION VERTICAL LIFT AND FORCE PUMP,

WITH INDEPENDENT STANDARD AND GEAR FOR STEAM POWER.

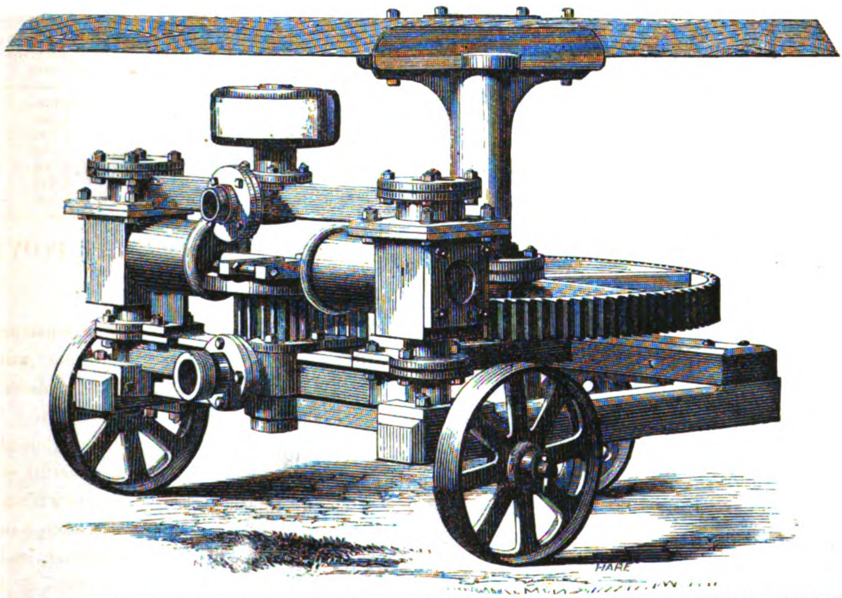
This Pump is mounted on stout cast-iron base plate and column, and is adapted for irrigation, or for any manufacturing purpose where it is requisite to raise *large quantities* of liquids, hot or cold. Being independent of any walls, &c. for support, it merely requires fixing firmly to the ground or floor, and may be driven by steam or any other motive power.

Diameter of Barrel.	Length of Stroke.	Iron Bored Barrel.	Brass Internal Barrel.	Gallons per Hour at 40 Strokes per minute.
Inches.	Inches.	£ s. d.	£ s. d.	
3	12	31 10 0	33 0 0	1,200
4	10	33 0 0	34 0 0	2,000
4	12	35 0 0	36 10 0	2,500
5	12	39 0 0	42 0 0	3,300
5	15	41 0 0	43 10 0	4,000
6	12	42 0 0	47 0 0	5,800
6	18	47 10 0	52 0 0	8,500

No. 19. DOUBLE ACTION HORIZONTAL LIFT AND FORCE PUMP,

MOUNTED ON BASE PLATE AND WITH GEAR.

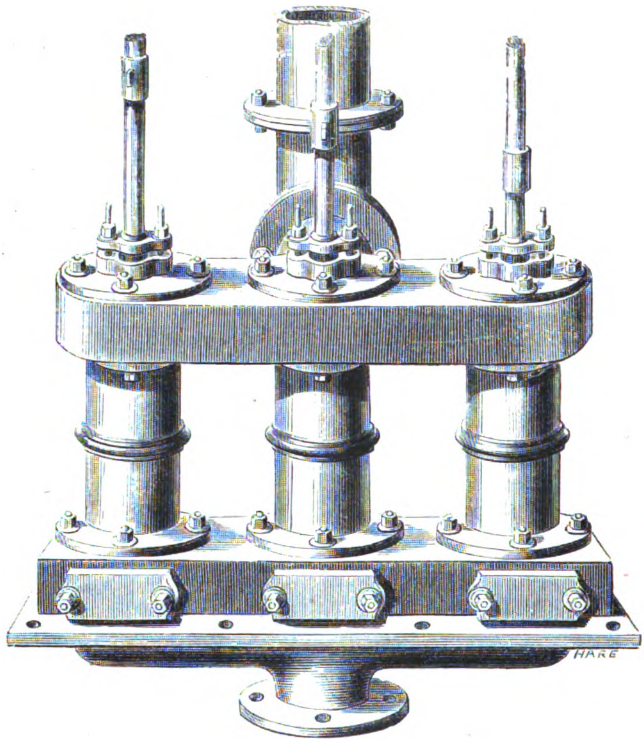
The general arrangement is the same as No. 18, except that it works HORIZONTALLY, which in some situations is more convenient, and the prices are about the same.



No. 20. PORTABLE LIFT AND FORCE PUMP AND CATTLE GEAR.

These Pumps were originally designed for irrigation, but they are equally applicable for raising water for any other purpose, and whilst being exceedingly portable and compact, they are so simple in construction that they can be set to work in a few minutes by inexperienced hands. The pinion, driven by the large spur wheel, has a disc plate and crank pin on its upper side, and the pumps are worked from a slotted link or crosshead as shown. The valves are plain india-rubber discs, with guards as described at p. 122, and they can be got at for examination by simply removing the covers on the valve chests. In the portable pumps the suction and delivery pipes are fitted for hose unions, but for fixed pumps (without wheels) the connections are usually for flange pipes. The poles are fitted with "whipple trees" and are used for draft poles when travelling. These pumps can also be adapted to drive by steam power. The subjoined prices include an air vessel over *each* valve box, and everything necessary for working, excepting the suction and delivery pipe, and the results stated are obtained with cattle travelling at a speed of 2 to 3 miles per hour.

Diameters.			Gallons per Hour.	Price.	Without Travelling Wheels. Less.	Weight about
Pump.	Suction.	Delivery.				
				£ s. d.	£ s. d.	cwt. qrs. lbs.
3	2	1½	500 to 700	20 0 0	1 10 0	12 0 0
4	2¼	2	1,000 to 1,300	25 0 0	1 15 0	15 0 0
6	3¼	3	3,000 to 4,000	30 0 0	2 0 0	17 0 0
8	5	4	5,000 to 7,000	40 0 0	2 10 0	20 0 0



TREBLE BARREL PUMP.

No. 21. IMPROVED SINGLE, DOUBLE, AND TREBLE BARREL LIFT AND FORCE PUMPS FOR DEEP WELLS.

With full water-ways and valves; door to each valve to give easy access for repairs, &c. The barrels all bored and flanges faced, all necessary valves, buckets, and rods, gun-metal stuffing boxes, and iron bows or cotters, ready for attaching to the well rods.

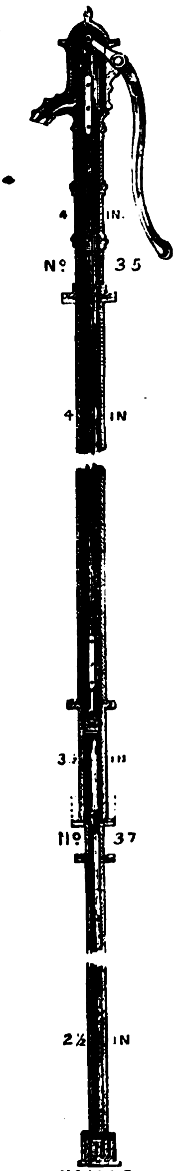
Diameter of Barrels.	Single Barrel. Iron.	Single Barrel. Brass.	Double Barrels. Iron.	Double Barrels. Brass.	Treble Barrels. Iron.	Treble Barrels. Brass.
Inches.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
2½	6 15 0	7 13 6	11 0 0	13 0 0	15 0 0	18 0 0
3	7 10 0	8 15 0	12 10 0	14 10 0	17 10 0	20 10 0
3½	9 0 0	10 5 0	14 10 0	17 0 0	20 0 0	24 0 0
4	11 0 0	12 5 0	16 10 0	19 0 0	27 0 0	32 0 0
5	17 10 0	20 0 0	25 0 0	28 0 0	40 0 0	45 0 0
6	26 0 0	29 0 0	38 0 0	42 0 0	58 0 0	65 0 0

If with cast-iron air-vessel, extra. If with copper air-vessel, extra.
For Hot Liquor add 11/0 per barrel.

These Pumps are fitted with cast-iron frame for top of well, with cranks, connecting rods, slings, and guides, and are worked by horse power, or steam power, as may be most convenient.

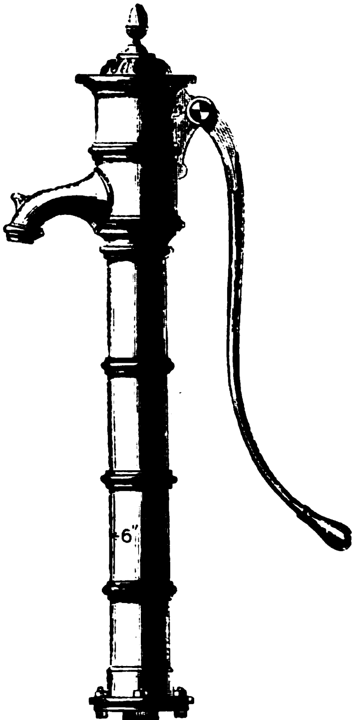
APPLEBY'S PATENT PUMPS,

Fitted with Patent Buckets and Conical Oscillating Valves, are Indestructible, and will Pump Cold or Hot Liquors.



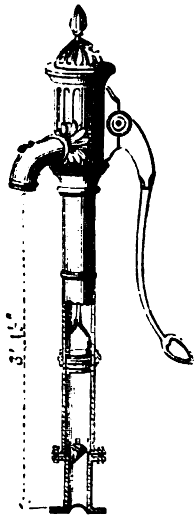
No 100 C

DEEP WELL PUMP No. 100 C.

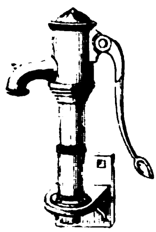


No 36P

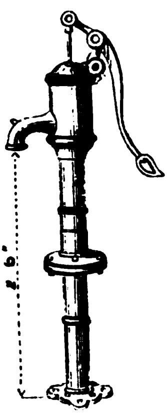
STREET PUMP.



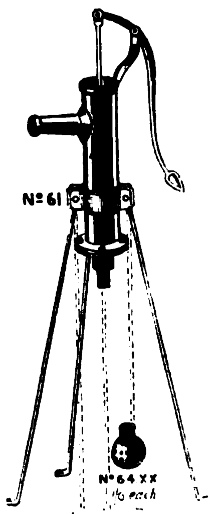
YARD OR TANK PUMP. No. 41.
Made all Sizes from 2½ to 5 in.
See Price List.



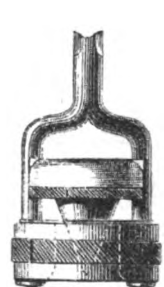
BRACKET PUMP. No. 32 B.



COTTAGE PUMP WITH VIBRATING MOTION. No. 33 XX.



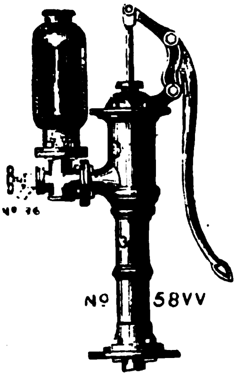
GALVANIZED IRON PUMP No. 61.



No 42.

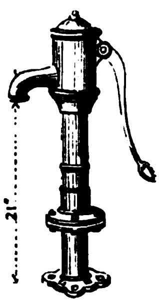
APPLEBY'S PATENT BUCKET AND OSCILLATING CONICAL VALVE, ENLARGED VIEW

APPLEBY'S PATENT PUMPS.—*continued.*

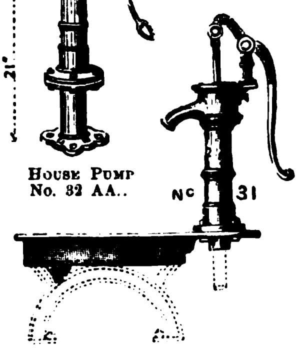


Lift & Force Pump
No. 58 VV.

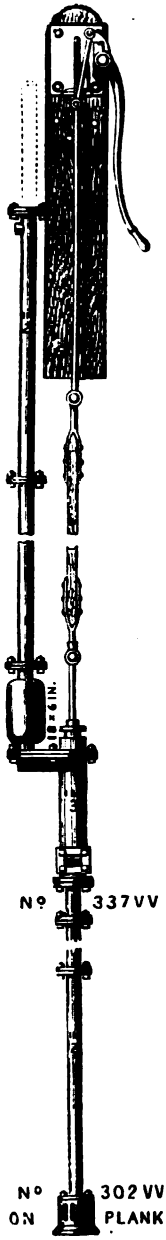
Lift Pump. No. 318.

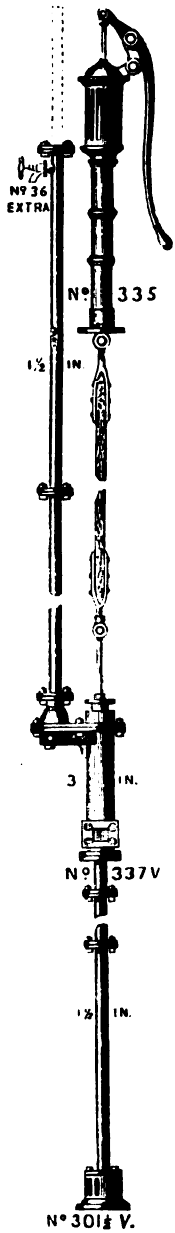


House Pump
No. 32 AA..

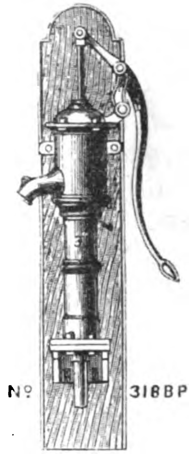


The Sovereign Pump. No. 31.
and Cast Iron Sink. No. 131.

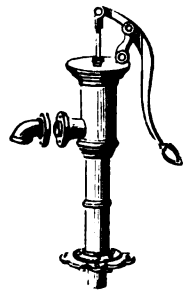




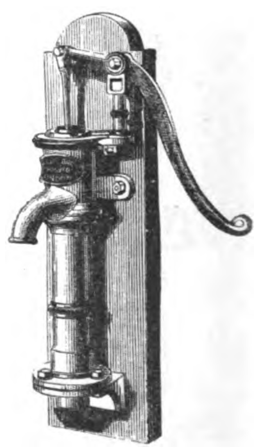
Deep Well Pumps.



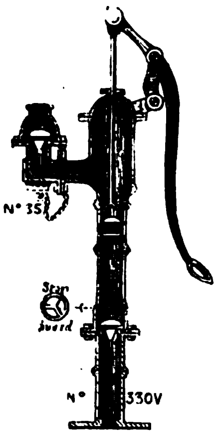
Bracket
Lift Pump
on Plank.
No 318 BP.



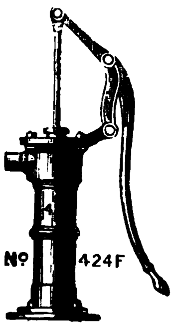
Lift and Force
Pump. No. 33 F.



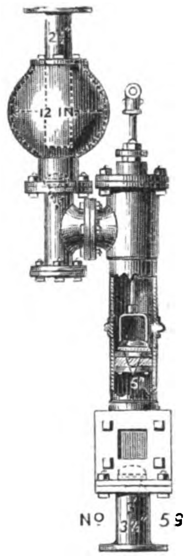
Bracket Lift Pump,
No. 31 BP.



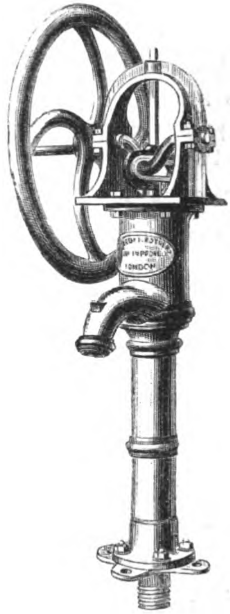
LIFT AND FORCE PUMP.
No. 330 V.



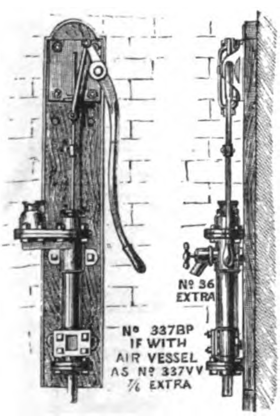
FOR WATER OR
LIQUID MANURE
CARTS, OR FOR
IRRIGATION.



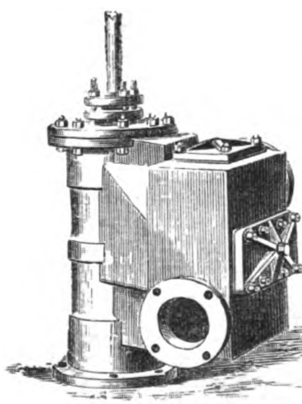
WORKING BARREL
FOR STEAM POWER.
No. 59.



LIFT PUMP, WITH CRANK
AND WHEEL MOTION.
No. 12.



LIFT & FORCE PUMP.
No. 337 BP.



DOUBLE ACTION LIFT AND FORCE
PUMP.

No. 14.

For Prices see page 122.

APPLEBY'S PATENT PUMPS.

Appleby's Patent Pumps are all fitted with their Patent Oscillating Conical Valves and Buckets, with indestructible packings, and will pump hot or cold water. All pumps are fitted with handles on right-hand side, unless ordered otherwise. The Barrels are all carefully bored and fitted.

It is requested that all orders may be given by No. or in the exact Terms of this List, to ensure Accuracy. Oil or Grease must not be used for Lubrication. Those Pumps marked * are Illustrated, the others are not.

LIFT PUMPS FOR WELLS 25 FEET DEEP AND UNDER.

No.		Price each
*12	**STANDARD ROTARY PUMP;** 18 inches under spout, with fly-wheel, handle, and wrought crank, prepared for flanged pipe, wrought-iron tube, or lead pipe,	

Bored Barrel	2½	3	3½	4 Inch.
If for Flanged Suction	1½	2	2½	2½ „
If Wrought-iron or Lead Suction	1½	1½	2	2 „
Price	£3 5s.	£3 10s.	£4 5s.	£5 10s.

No.		£	s.	d.
*31	**2½ Inch SOVEREIGN PUMP;** 12 inches under spout, fitted with reversible cap and handle, bored and tapped to suit 1½ inch iron tube, &c.	1	0	0
*31BP	**2½ Inch PUMP;** 12 inches under spout, fitted with reversible cap and handle, bracket with lugs bolted to strong plank, bored and tapped to suit 1½ inch wrought-iron tube	1	7	6
	If with bracket, but without plank	1	2	6
*131	**INDEPENDENT PORTABLE SINK, OR WATER AND PUMP STAND, fitted with air trap; for 1½ Inch iron tube to conduct waste water to the well or drain, &c. 30** by **18** by **21 inches high, outside**	0	15	0
*32AA	**2½ Inch HOUSE PUMP;** 20 inches under spout, fitted with tailpiece to suit either 1½ inch flanged pipe, or wrought iron tube	1	2	6
*32B	**2½ Inch PUMP, fitted with BRACKET, PEDESTAL and LUGS;** 13 inches under spout, for bolting to wall, plank, or cart, to suit 1½ inch iron tube, &c.	1	5	0
	N.B.—If fitted on strong plank, 5s. extra.			
*33XX	**2½ Inch PATENT COTTAGE PUMP;** 30 inches under spout, fitted with reversible cap and handle, and standard pipe for either 1½ inch flanged pipe, or iron tube, &c.	1	7	6
34	**4 Inch LIQUID MANURE PUMP;** 6 ft. 6 in. under spout, with strong wrought iron handle, 3 in. tail piece and extra large valve	3	0	0
*318	**3 Inch PUMP;** 18 inches under spout, fitted with reversible cap and handle, to suit 1½ inch iron tube, &c.	1	7	6
*318B	**3 Inch PUMP;** 18 inches under spout, fitted with reversible cap and handle, and **Bracket Pedestal with Lugs,** to suit 1½ inch iron tube, &c. **(as No. 318BP without Plank)**	1	10	0
*318BP	**3 Inch PUMP;** 18 inches under spout, fitted with reversible cap and handle, **Bracket with Lugs bolted to strong plank** to suit 1½ inch iron tube, &c.	1	17	6
324	**3 Inch PUMP;** as 318, except 24 inches under spout, fitted with reversible cap and handle, and tailpiece to suit either 1½ or 2 inch flanged pipe, or 1½ inch iron tube, &c.	1	10	0
330	**3 Inch PUMP;** as 318, except 30 inches under spout, fitted with reversible cap and handle, and standard pipe to suit either 1½ or 2 inch flanged pipe or 1½ inch iron tube, &c.	1	12	6
36P	**6 Inch STREET or ROAD PUMP;** 4 feet under spout, fitted with extra strong wrought iron handle, and 4 inch tailpiece for flanged suction pipe. **Will lift 2,202 gallons per hour (or No. 648 with reversible cap, 10s. extra)**	5	10	0
	N.B.—No. 36P or 648 can be made 5 or 6 feet high under spout if required. Charged extra. These Pumps are invaluable for Roads, Breweries, and large establishments.			
424	**4½ Inch LIFT PUMP, size as No. 424F; 24 inches high, fitted with straight or curved spout below the head, and bracket pedestal if ordered; for water or liquid manure carts, &c.**	2	10	0
61	**4½ Inch STRONG GALVANIZED IRON PUMP FOR LIQUID MANURE,** fitted with wrought iron tripod, portable legs, and connecting piece to suit 2 inch suction hose, or iron tube	2	12	6
57XX or 64XX	**Strainer** for Suction Hose for ditto	0	1	6

LIFT PUMPS FOR WELLS 25 FEET DEEP AND UNDER—*continued.*

No.	Bore of Pump Barrels	2½	3	3½	4	4½	5	6	Inch.
	Bore of Suction Pipes	1½	2	2½	2½	3	3½	4	Inch.
41	**IMPROVED PUMPS with FLUTED PATTERN HEADS and Caps;** 3 feet high under spout, fitted with tailpiece, &c. to suit flanged pipe	36/0	42/0	45/0	50/0	60/0	75/0	...	Each.
41L	**Same pattern, and fitted as No. 41, except 4 feet under spout** . Can be made from 4½ to 6 feet under spout, from 6*s.* to 12*s.* extra.	38/6	44/6	47/6	52/6	63/0	77/6	...	Each.
41 & 41 L	**If fitted to suit wrought iron tube, same price as above.**								
41X	**Best copper linings fitted into bored iron barrels, charged extra**	6/6	7/6	8/6	10/6	12/6	20/0	...	Each.
42B & 44B	**IMPROVED BRASS BUCKETS, with conical clack valves, extra on each pump or barrel**	4/0	5/6	7/6	8/6	10/0	12/0	24/0	Per set.

N B.—No. 41 pumps are the best made for general purposes and constant use.

APPLEBY'S IMPROVED DEEP-WELL LIFT PUMPS, FOR WELLS FROM 27 TO 100 FEET DEEP.

	Pump top and Main Pipe.	Bored Working Barrel. No. 37.	Suction Pipe.	Price Complete, for 30 feet deep.	Extra per Foot, if exceeding 30 Feet.	Extra, with Bucket Door to Barrel.	Extra for Copper Lining to Barrel.	Extra, for Brass Buckets and Valves.
Deep-well Pumps with fluted case (as No. 85) strong wrought iron handle, detached bored working barrel, and all the latest improvements; clack-door, tailpiece, impervious wooden connecting rods, 9 feet of main pipe, 19 feet of suction pipe (including strainer), and all bolts, nuts, washers, &c. complete and ready for fixing, for 30 feet deep	in.	in.	in.	£ *s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d.*	*s.* *d*
100A.—Ditto	3	2½	1½	4 10 0	2 0	9 0	6 6	4 0
100B.—Ditto	3½	3	2	5 0 0	2 6	10 0	7 6	5 6
***100C.**—Ditto	4	3½	2¼	5 15 0	2 9	12 0	8 6	7 6
100D.—Ditto	4½	4	2½	6 10 0	3 0	15 0	10 6	8 6
100E.—Ditto	5	4½	3	7 10 0	3 3	20 0	12 6	10 0

***** Inside dimensions are always given.**

DEEP-WELL PUMPS with PILLAR PUMP CASE, 4 feet high, vibrating motion, wrought iron handle and rod, with connecting joints, pins, and cotters, **3 inch working barrel,** 2 feet, 6 inches long, with turned rod, gland, and stuffing box, patent bucket and valves, elbow with retaining valves, clack-door, &c., including 9 feet of wood rod, and iron forked straps, with connecting joint at each end; 18 feet 6 inches of flanged suction pipe, with patent strainer, 12 feet flanged rising main pipe, bolts, nuts, and patent washers for all the pipe joints, ready for fixing, viz.:—

***No. 301½V.—Pump,** as shown, with 1½ inch flanged pipe, **3 inch** Barrel, &c. complete for Well 30 feet deep, £5 17*s.* 6*d.* Extra per foot, 1*s.* 1½*d.* if exceeding 30 feet.

***No. 302VV.—Pump on Plank,** as shown, with 2 inch flanged pipe, **3 inch** barrel, &c. complete, for Well 30 feet deep, £6 15*s.* Extra per foot 1*s.* 4½*d.* if exceeding 30 feet.

PATENT LIFT AND FORCE PUMPS,

FITTED WITH TURNED RODS, BRASS BUSHES, REVERSIBLE CAPS AND HANDLES.

***No. 12F** **STANDARD ROTARY FORCE PUMP, (same pattern as No. 12)** with heavy fly-wheel, and 2 handles, wrought iron crank and guide rod, brass stuffing box, air vessel with retaining valve, patent oscillating conical valves, and prepared for lead, wrought iron, or flanged pipes,

Bored Barrel	2½	3	3½	4
If for Flanged Suction	1½	2	2½	2½
Wrought-iron or Lead Suction	1½	1½	2	2
Price	£5.	£5 10*s.*	£6 10*s.*	£8.

PATENT LIFT AND FORCE PUMPS—*continued.*

No.		Price each.
*33F	**2¼ Inch;** fitted with flanged base plate, to suit 1¼ inch iron tube for suction and rising main; 14 inches under branch	2 2 0
318F	**3 Inch;** fitted with flanged base plate (as **33F,** no elbow or retaining valve), to suit 1½ inch iron tube for suction and rising main; 18 inches under branch	2 7 6
*330V	**3 Inch;** fitted with elbow, retaining valve, and dome cap; to suit either 1½ inch flanged pipe or iron tube, for suction and rising main, 30 inches under elbow	2 15 0
318VV	**3 Inch;** fitted with elbow, air vessel, and retaining valve, flanged base plate to suit 1½ inch iron tube, 18 inches under elbow (**as No. 58VV**)	3 0 0
*337BP	**3 Inch Pump,** with strong fulcrum plate bolted to plank 60 × 11 × 3 inches, retaining valve and air cap If with large air vessel (as **58VV**) 7*s.* 6*d.* extra.	4 14 6
58F	**3½ Inch;** fitted with flanged base plate (as **33F,** no elbow or retaining valve), to suit 2 inch iron tube for suction and rising main; 22 inches under branch	2 15 0
58V	**3½ Inch;** fitted with elbow, retaining valve, and cap; to suit either 2 inch flanged suction pipe or iron tube; 36 inches under elbow, (as **No. 330V**)	3 5 0
*58VV	**3½ Inch;** fitted with elbow, retaining valve, and air vessel, flanged base plate; to suit 2 inch iron tube for suction and rising main; 22 inches under elbow	3 10 0
*59	**5 Inch; Working Barrel,** for steam power, fitted with gland and tighted stuffing box, extra strong turned rod, and cotter joint to disconnect bucket, the pipe with retaining valve, globular air vessel 12 inches inside, to suit 3 or 3½ inch flanged suction, and 2½ inch rising main pipes 39 inches high, 31 inches under branch	7 0 0
*424F	**4½ Inch;** fitted with wrought iron handle, 2½ inch tailpiece or elbow, to suit suction, and branch nozzel for 2 inch delivery hose; 24 inches high, made for fixing on barrow frames, &c. to irrigate gardens, pleasure grounds, farms, &c.	3 5 0
436VV	**Fitted similar to No. 59, with smaller air vessels and tailpieces in usual proportions,** 36 inches high extreme, for motive power, 3 inch bore 72/6 each, 3½ inch 80/0 each, 4 inch 87/6 each	
636	**6 Inch Strong Engine Pump,** fitted with gland and tighted stuffing box, 1½ inch turned rod and cap, with cotter to disconnect bucket, extra large elliptical air vessel, with retaining valve. To suit 4 inch flange rising main and suction pipe, 48 inches high, 36 inches under branch	11 0 0

No.	Bore of Pump Barrels	2½	3	3½	4	4½	5		Inch.
*37	**BORED WORKING BARRELS** for deep wells, fitted with Appleby's patent bucket and clack valve, clack door, and tail piece, 30 INCHES high, proved	21*s.*	25*s.*	30*s.*	35*s.*	40*s.*	50*s.*	...	Each.
38	**BORED WORKING BARRELS** for deep wells, with doors for bucket, and clack valve, bucket rod fitted with brass coupling box, in other respects as No. 37—36 INCHES long, proved	30*s.*	35*s.*	42*s.*	50*s.*	60*s.*	70*s.*	...	Each.

PUMP PIPES, &c.

Bore	1	1¼	1½	2	2½	3	3½	4	Inch.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	
Flanged Pump Pipes, proved to a high pressure, per foot	...	...	0 8	0 11	1 1	1 5	1 7	1 10	per ft.
(1½, 2, 2½ inch are made 6 feet long; 3 inch and upwards are 6 feet or 9 feet long; irregular lengths charged extra.) 3 feet and under, each	...	...	2 3	3 0	3 6	4 9	5 3	6 0	each.
Flanged Elbows, 6 inches each way, from inside to face of flanges	...	...	3 0	3 6	4 3	5 0	5 9	6 6	,,
Bolts, Nuts, Washers, and Elastic Rings to suit flanged pipe joints, per set	...	...	0 8	0 9	0 10½	1 6	1 9	2 0	pr set.
Bolts, Nuts, and Iron Washers only, per dozen	...	...	1 9	1 9	2 0	2 3	2 3	2 6	dozen.
Wrought Iron Tubes, per foot	0 4½	0 6½	9	1 1½	...	...	...	...	per ft.
Ditto Bends, each	0 8	1 2	1 6	2 6	...	...	...	...	each.
Tinned connecting pieces for soldering, each	...	1 3	1 6	2 0	...	...	...	...	,,

WINDBORES OR STRAINERS FOR BOTTOM OF SUCTION PIPES.

Bore	1	1¼	1½	2	2½	3	3½	4	Inch.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
No. 47. Strainer, 12 inch long, each	...	...	2 0	2 9	3 3	4 3	4 9	5 6	each.
No. 47S. Strainer with fine Meshes, (as shown, 301½V), each	...	...	3 0	3 3	3 6	4 0	...	...	,,
No. 57XX, or 64XX. Ditto for wrought Iron tube, or flexible hose, each	...	...	1 6	1 6	2 0	...	...	...	,,
No. 35. Brass Plug Cap, with chain, screwed for wrought iron tube	...	3 6	3 6	...	...	...	...	...	,,
No. 36. Iron Water Tap, Brass Screw, and screwed to suit Iron Gas Thread	4 6	5 6	6 6	...	...	...	...	...	,,
No. 37T. Galvanized Iron Bib-nosed Taps, Metal Plugs, screwed ends for wrought iron Tube, each	4 6	9 0	11 0	...	...	...	...	...	,,
No. 44F. Retaining Valve for wrought iron tube or flanged pipes, each (as shown on No. 330V, 301½V, &c.)	...	...	7 6	8 6	10 6	14 0	17 6	25 0	,,
Cast Iron retaining Valve and Air Vessel, with two flanges and doorway to valve for an upright pipe, each	...	...	24 0	25 0	28 0	33 0	37 6	43 6	,,

APPLEBY'S IMPROVED LIFT AND FORCE PUMPS.

WITH PATENT BUCKETS AND OSCILLATING CONICAL VALVES.

WELL ENGINE FRAME AND POWER PUMPS FOR DEEP WELLS.

No. £ s. d

72. LIFT and FORCE PUMP, with Strong Single Crank Well Engine Frame, fitted, trued, and bolted to cast iron **Foundation Plate,** 36×18 inches, with guide and sling motion, **Heavy Fly Wheel** 42 in. diameter, with balance weight and 2 winch handles, tight gland and stuffing box, **Standard Head,** main pipe with wood rod, bored working barrel with bucket and clack doors, bucket with all the latest improvements, brass coupling box to disconnect iron rod, 18½ feet suction pipe, including strainer, bolts, nuts, and elastic washers for all the joints; as stated below, viz:—

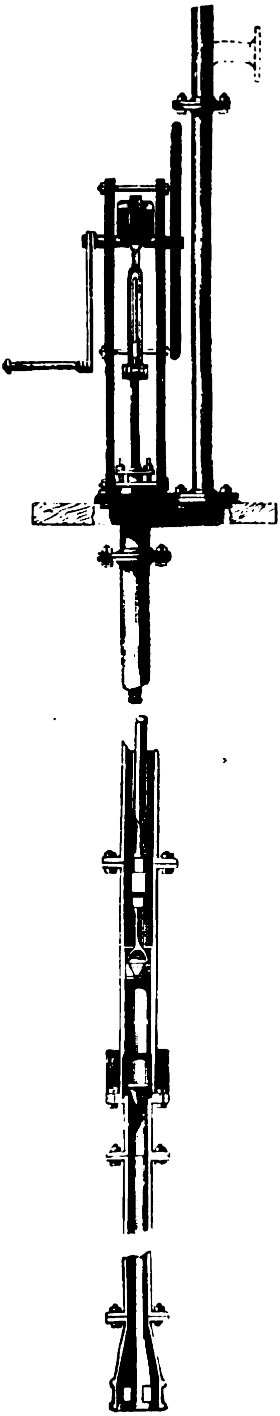
Bore of Barrel.	Main Pipe.	Suction Pipe.	Price complete for Well 30 feet deep.	Extra if exceeding 30 feet deep, per foot.	Extra for Copper lined Working Barrel.	Extra for Brass Buckets and Valves Per Set.
			£ s. d.	s. d.	s. d.	s. d.
3 in.	3 in.	1½ in.	17 15 6	2 0	6 6	4 0
,,	3 ,,	2 ,,	18 5 0	2 0	7 6	5 6
3½ ,,	3½ ,,	2½ ,,	18 17 6	2 6	8 6	7 6
4 ,,	4 ,,	2½ ,,	19 10 0	2 9	10 6	8 6

Extra, if fitted with 2 fly wheels, &c. 2 0 0

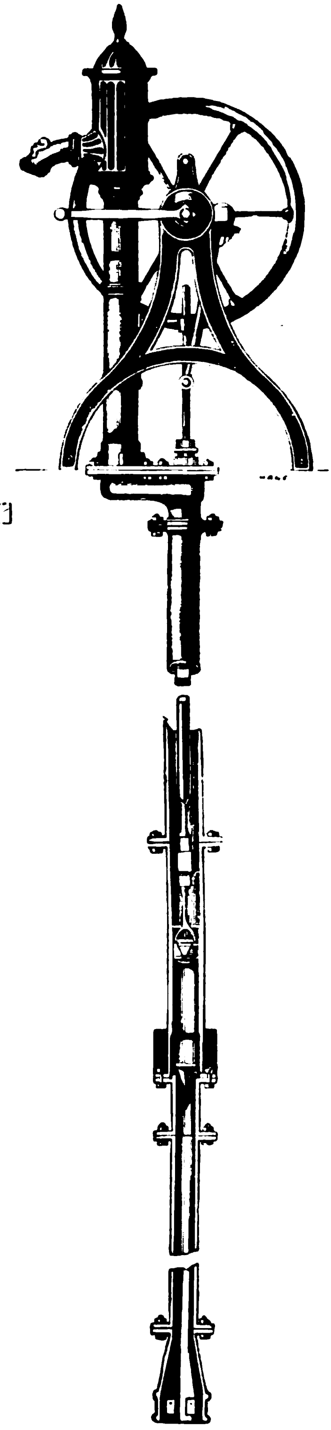
3. LIFT and FORCE PUMP, as shown at page 134, with Strong Single Crank Well Engine Frame, fitted, trued, and bolted to cast iron **Foundation Plate,** 36×18 inches, with lever guide, **Heavy Fly Wheel** 42 inches diameter, with balance weight and 2 winch handles, **Standard Head,** 2½ inch rising main pipe, 4 inch bored working barrel with clack door, and all the latest improvements, wood rods, guides, &c. 3 inch tee pipe, 12 inch globular air vessel, 2½ inch dip pipe to suit rising main, 18½ feet of 2½ inch suction pipe, including strainer, bolts, nuts, and elastic washers for all the joints. Complete for well 30 feet deep 20 0 0

Extra, if exceeding 30 feet deep for 2½ inch flanged main pipe, wood rod, guide &c. per foot . . 0 1 10

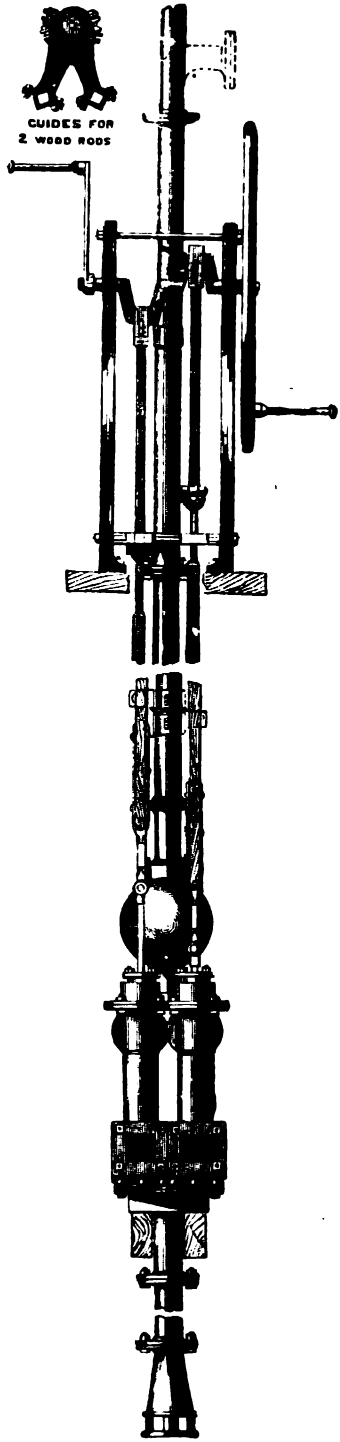
74. LIFT and FORCE PUMP, with Strong Single Crank Well Engine Frame, fitted, trued, and bolted to cast iron **Foundation Plate,** 36×18 inches, with guide and sling motion, heavy fly wheel, 42 inches diameter, with balance weight and 2 winch handles, tight gland, and stuffing box, main pipe with wood rod and guide, bored working barrel with bucket and clack doors, bucket, &c. with all the latest improvements, brass coupling box to disconnect iron rod, 18½ feet suction pipe, including strainer, bolts, nuts, and elastic washers for all the joints, as stated below, viz:—



Pump No. 74.



Pump No. 72.



Pump No. 75

(No. 74.) IMPROVED LIFT AND FORCE PUMPS—*continued.*

Bore of Barrel.	Main Pipe.	Delivery Branch.	Suction Pipe.	Price complete for Well 30 feet deep.	Extra if exceeding 30 feet deep, per foot.	Extra for Copper lined Working Barrel.	Extra for Brass Buckets and Valves Per Set.
				£ s. d.	s. d.	s. d.	s. d.
2½ in.	3 in.	2 in.	1½ in.	17 2 6	2 0	6 6	4 0
3 ,,	3 ,,	2 ,,	2 ,,	17 12 6	2 0	7 6	5 6
3½ ,,	3½ ,,	2½ ,,	2½ ,,	18 5 0	2 6	8 6	7 6
4 ,,	4 ,,	2½ ,,	2½ ,,	19 0 0	2 9	10 6	8 6

If fitted with standard head, brass plug and chain, which may be used as a Lift Pump, or Force Pump . . . . . extra 2 0 0
Extra, if fitted with 2 fly wheels for deep wells . . . . . each 2 0 0

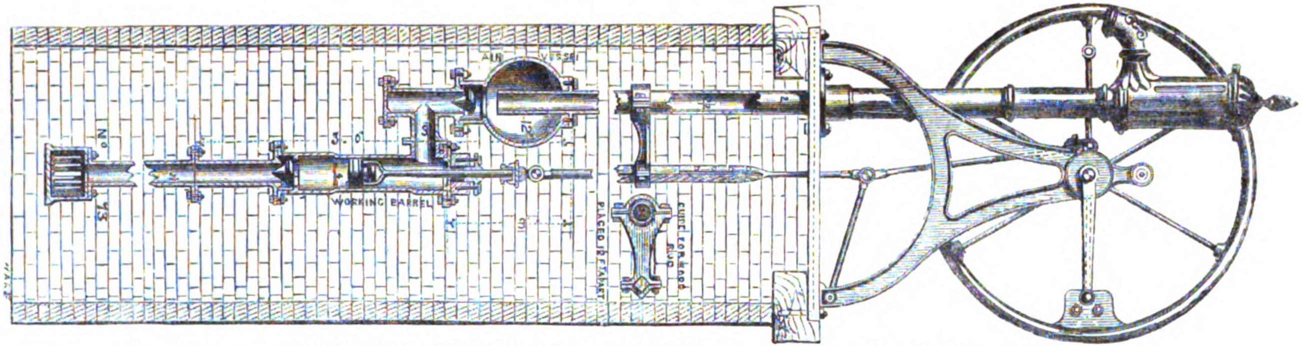
75. **LIFT and FORCE PUMP, with Strong Well Engine Frame,** fitted, trued, and bolted to cast iron **Foundation Plate,** 36 × 24 inches, strong wrought iron **Double Throw Crank,** connecting rods with strap heads and lever guides, **heavy fly wheel,** 42 nchesdiameter, with 2 winch handles, the side frames bolted together with strong wrought ronstretcher bars, iron pump rods with forked straps (wood rods disconnected), double rod guide, **2 3½ inch working barrels,** fitted with the latest improvements; Turned rods, joints, tight glands and stuffing boxes, buckets and valves, connecting delivery syphon, globular air vessel, 12 inches inside, fitted with retaining valve, 2½ inch dip pipe, 2½ inch rising main pipe and elbow, 18½ feet of 2½ suction pipe, including strainer, bolts, nuts, and elastic washers for all the joints. Complete for well 30 feet deep 28 5 0
Extra, if exceeding 30 feet deep, for 2½ inch rising main flange pipe, with 2 wood rods, guides, bolts, nuts, and washers, to suit 0 2 7
Extra, if fitted with 3 inch **Standard Pump Head,** the spout 8 feet from the ground line, fitted with strong brass plug, turned and chased, suspended with galvanized iron chain (bottom flange with boss), tapped to suit 2 inch iron tube 2 0 0
Extra for 2 inch wrought iron tube . . . . . per foot 0 1 1½
Extra for 2 inch bends to suit . . . . . each 0 2 6

76. **LIFT and FORCE PUMP, with Strong Well Engine Frame, 2 3½ inch Working Barrels, &c.** in principle as No. 75, the **Standard Head** and rising main pipe bolted to the **Foundation Plate,** the top rising main pipe with boss cast on which may be bored and tapped for 1½ or 2 inch delivery pipe to lead to cisterns, &c. placed on higher elevations fitted complete for well 30 feet deep 30 0 0
Extra, if exceeding 30 feet deep, for 2½ inch rising main flanged pipe with 2 wood rods, guides, bolts, nuts, and elastic washers to suit . . . . . per foot 0 2 7
Extra for best copper lining fitted to bored working barrels . . . . . per set 0 17 0
Extra if fitted with 2 fly wheels 2 0 0
Extra, if fitted with turned pulley for power, 15 inches diameter and 4½ inch on face 1 0 0

77 **LIFT and FORCE PUMP, with Improved Strong Cast Iron Well Engine Frame,** fitted, trued, and bolted to **Strong Foundation Plate,** 48 × 30 inches, best **Wrought Iron Three Throw Crank,** connecting rods fitted with strap heads and brasses, gibs, and cotters lever guides and short well rod screwed to suit wrought iron tube, **Heavy Fly Wheel** 42 inches diameter, 2 winch handles, **Spur Wheel and Pinion to decrease Speed** in ratio of 2 to 1, or 3 to 2, the side frames bolted together with strong wrought iron stretcher bars, complete, ready for fixing, **3 3-inch Working Barrels,** with doors for access to valves, fitted with all the latest improvements, turned rods, joints, tight glands, and stuffing boxes buckets and valves, elliptical air vessel 18×7 inches outside, with retaining valve, wrought iron tubular rods to attach to frame work, 18½ feet of 2½ inch suction pipe, including strainer, bolts, nuts, and elastic washers for all the joints, and 2½ inch rising main to reach to ground line. Complete for well 30 feet deep 41 10 0
Extra, if exceeding 30 feet deep, for 2½ inch main flanged pipe, with 3 tubular rods, bolts, nuts, and elastic washers to suit . . . . . per foot 0 3 6
Extra if fitted with two fly wheels 2 0 0
Extra, if fitted with turned pulley for power, 15 inches diameter, and 4½ inches on face . . . 1 0 0
Extra for best copper linings fitted to bored working barrels . . . . . per set 1 2 6

Approximate Quantity of Water which may be lifted by one Man working 30 full Strokes per Minute. Result per hour, about—

2½	3	3½	4	4½	5	6	Inch Barrel.
223	344	520	713	1032	1274	2202	Imprl Gals



PUMP No. 73.
See page 131.

No. 100 F.—APPLEBY'S IMPROVED DEEP WELL LIFT AND FORCE PUMPS,
FOR WELLS 27 TO 100 FEET DEEP.

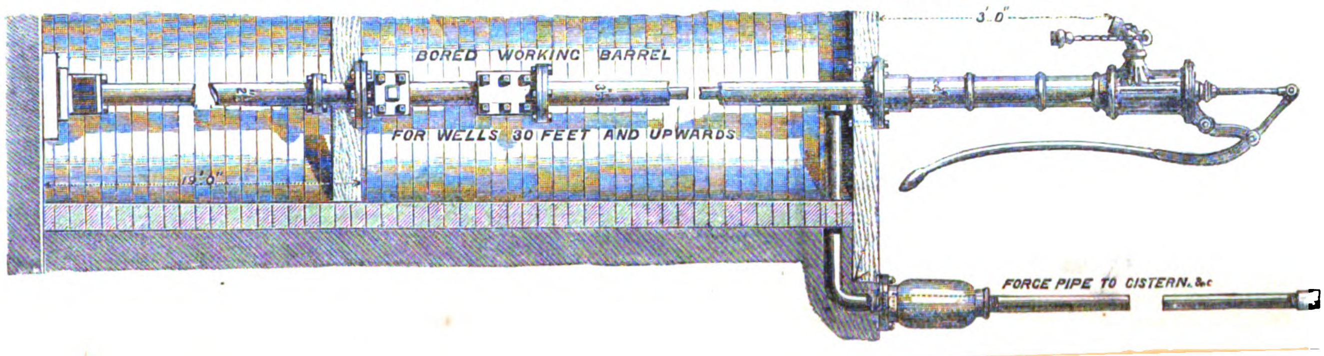
THE general description and dimensions are the same as No. 100 A, &c. (see page 129), except that the fluted case is fitted with brass stuffing box, and the spout has a brass screwed cap, to attach *when used as a Force Pump*, and a boss is cast on the rising main close under the ground line, which at an extra charge of 1*s*. may be screwed for force pipe if required, the air vessel may be used or omitted, and the force pipe is not included in the prices.*.

	2½ inch.	3 inch.	3½ inch.	4 inch.
Working Barrel				
Price, complete, for 30 feet deep, exclusive of force pipe	£6 10 0	£7 5 0	£8 0 0	£9 5 0 each.
Extra per foot, if exceeding 30 feet	2/0	2/6	2/9	3/0 per foot.

No. 41 F. LIFT and FORCE PUMPS for WELLS not exceeding 25 feet deep, same pattern as No. 100 F, except that the working barrel is placed close under the ground line, to admit of the force pipe being placed in the same position as described above.

	2½ inch.	3 inch.	3½ inch.	4 inch.
Working Barrel				
Price of Pump, exclusive of suction or force pipes	£4 10 0	£4 15 0	£5 7 6	£5 15 0 each.

* Price of Cast Iron Flanged Pipes and Wrought Iron Tubes, see page 120, and of Air Vessels, page 131.

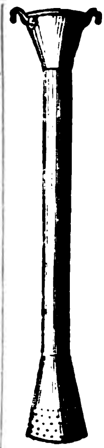


PUMP No. 100 F.

(No. 50.) PORTABLE WROUGHT IRON CONTRACTORS' PUMPS.

7 feet high under spout.

Bore.	Painted.	Galvanized.	Suction, per foot extra over 7 feet.		Telescope slides for pumps.
			Painted.	Galvanized.	
3 in.	£2 2 0	£2 7 6	1/0	1/6	
4 in.	2 15 0	3 0 0	3/0	3/6	40/0
5 in.	3 0 0	3 7 6	3/6	4/0	45/0
6 in.	3 15 0	4 5 0	4/0	4/6	50/0
7 in.	4 10 0	5 5 0	4/6	5/0	55/0
9 feet under spout.			Over 9 feet.		
8 in.	6 15 0	8 10 0	5/6		70/0
9 in.	8 10 0	10 10 0	7/0		90/0



(No. 51.) STRONG WROUGHT IRON CONTRACTORS' PUMPS, with flanged suction pipes, bolts, nuts, and packings, and sliding suction complete, for 28 feet under spout :—

Diam. of barrel . . .	4	5	6	7 inches.
	£6 17 6	£7 17 6	£9 5 0	£10 12 6 each.

(No. 52.) SINGLE BARREL STRONG PORTABLE WROUGHT IRON PUMPS for CONTRACTORS or WELL-SINKERS, with brass bucket and clack valve, square cistern head, wrought iron double lever handles with bows, one length of rising main with pump rods to suit, suction pipes, and all joints complete, for 36 feet deep :—

Bore of Working Barrel	3½	4	5	6 inches.
Price complete for 36 ft. deep . .	£18 0 0	£20 0 0	£25 10 0	£32 0 0
For Rising Main with flanged joints and pump rods to suit, extra per 9 feet length, exceeding 36 feet deep	2 5 0	2 10 0	3 0 0	3 10 0

These pumps will work from 20 to 200 feet deep.

(No. 53.) DOUBLE BARREL STRONG PORTABLE WROUGHT IRON PUMPS for CONTRACTORS, &c. with wrought iron cistern heads; with slings, guides, wrought iron double lever handles with long ash staves, suitable for a large or small number of men, bored barrels and packed plungers, strong wrought iron collared suction pipe, flanges with bolts, nuts, and packings, and a length of telescope sliding suction; complete, for 28 feet below spout :—

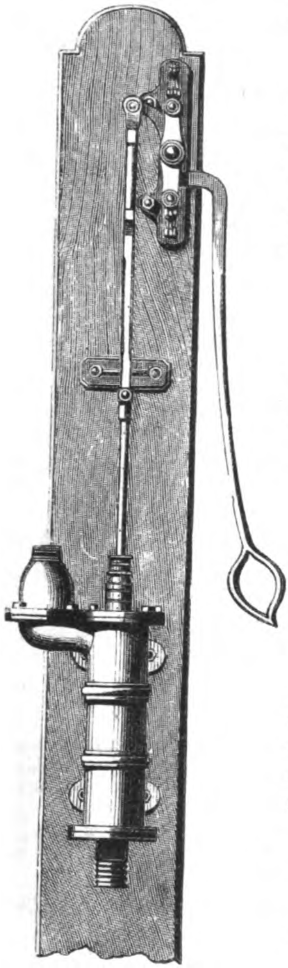
Bore of Working Barrel	6	8	10	12 inches.
Price complete for 28 feet deep, *without doors* for access to valves	£25 0 0	£40 0 0		
Ditto ditto *with* doors for access to valves	—	45 0 0		
Ditto ditto, for STEAM POWER, finishing at the Rocking Lever, ready for driving gear, if *without* doors	—	—	£65 0 0	£75 0 0
Ditto ditto, *with* doors . . .	—	—	70 0 0	80 0 0

BRASS LIFT AND FORCE PUMPS ON PLANKS.

No. 432.

BRASS LIFT AND FORCE PUMP ON PLANK, with slings and guides, and wrought iron handle, brass stuffing box, and prepared for lead suction and delivery :—

Bore of barrel . .	2	2½	3	3½	4	4½	5 inches.
	£ s.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s.	£ s.
Best strong quality	4 0	5 5 0	6 6 0	7 7 0	8 8 0	12 15	17 17 each.
Second quality .	3 14	4 5 0	5 5 0	6 7 6	7 7 6		,,
Third quality . .	3 0	3 8 6	4 7 6	5 7 6	6 7 6		,,



No. 432.

No. 432A.

BRASS LIFT AND FORCE PUMP ON PLANK, with rotary motion, fly-wheel, and handle :—

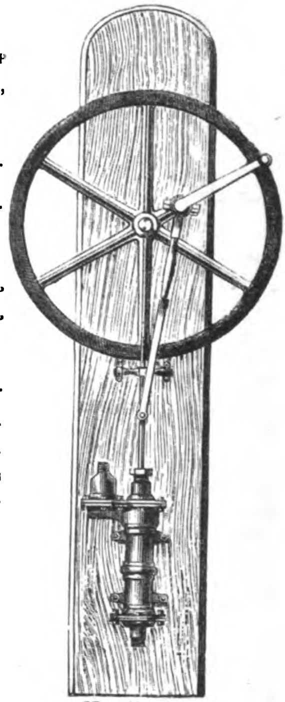
Bore of Barrel	2½	3	3½ inches.
Price	£6 6 6	£7 7 0	£8 8 0 each.

No. 431A.

BRASS LIFT AND FORCE PUMP ON PLANK, suitable for DEEP WELLS.

STRONG WROUGHT IRON DEEP WELL PUMP HANDLE, mounted on Plank (with side action) with carriage, brass bearings, slings and guides, to work right or left hand, and suitable for

DEPTHS OF	PRICE
20 to 30 ft. .	£2 11 0 each.
40 to 50 ,, .	£2 13 0 ,,
60 to 70 ,, .	£2 16 0 ,,
80 to 100 ,, .	£2 19 0 ,,



No. 432A.

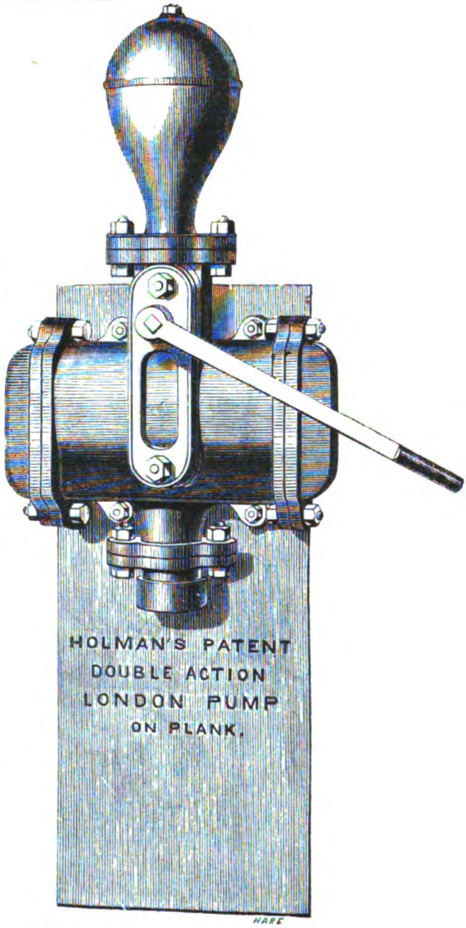
PUMPS on Square Tails with iron bows,—

Bore	2	2½	3	3½	4	4½	5 in
For Shallow Wells.	£2 8 0	£3 0 0	£3 18 6	£4 12 6	£5 18 0		each.
Extra strong Pumps for Deep Wells .	2 12 6	3 6 0	4 5 0	5 0 0	6 8 0	9 10 0	14 0 ,,

Prices of Pump Rods and Couplings see page 179.
Ditto Pipes, Lead, see page 182.
Ditto Ditto, Wrought Iron, see pages 130 and 183.
Ditto Ditto, Copper, see page 182.
Ditto Roller Guides and Sundry Fittings, see pages 179.

LAY SHAFT WITH BEARINGS, for positions where the pump handle or plank is at a distance from, or cannot be placed over the Well

The Price for about 8 feet of Shafting and 2 Plummer Blocks with the necessary joints and cranks at each end, will add about £3 to £3 10s. to the prices of Pumps 301½ V 302 VV. or 431 A. &c.



(No. 500.)

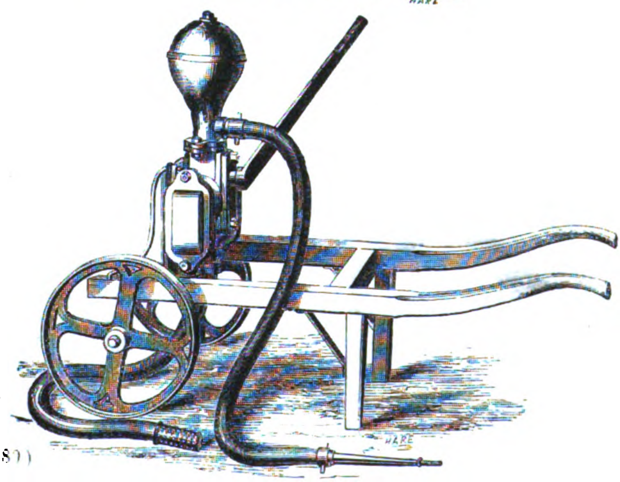
THE LONDON DOUBLE-ACTION PUMP, ON PLANK.

Is compact, strong, simple, and inexpensive, suitable for house, farm, or garden purposes, or for export.

Diam. of Cylinder.	Price with Air Vessel. £ s. d.	Price without Air Vessel. £ s. d.
2½ in.	3 0 0	2 15 0
3 ,,	3 10 0	3 2 6
4 ,,	4 10 0	4 0 0
5 ,,	6 0 0	5 10 0
6 ,,	7 10 0	7 0 0

(No. 501.)

LONDON PUMP ON BARROW.

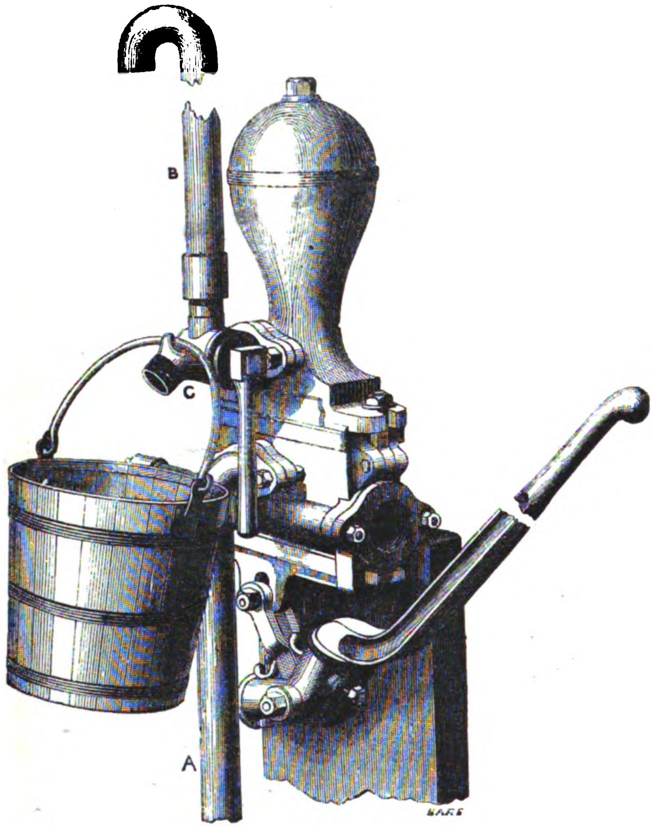


Diam. of Cylinder.	Price. £ s. d.
2½ in.	5 0 0
3 ,,	5 10 0
4 ,,	6 10 0
5 ,,	8 0 0
6 ,,	9 10 0

Hose, Branch Pipes, &c. extra.

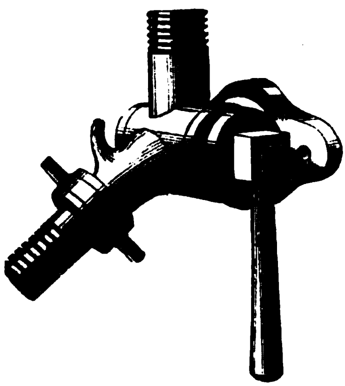
(For Prices see pp. 178, 180.)

(No. 502.) CALIFORNIA DOUBLE ACTION HOUSEHOLD LIFT AND FORCE PUMP ON PLANK.



The California Pump is worked by one or two handles, removable at pleasure, and secured by set screws in the sockets. Being double action the water is delivered in a continuous stream. The Pump is suitable for wells not exceeding 25 feet deep, either for delivery at the spout, as shown, or for forcing to any height required through the upright pipe, or by attaching a hose and hand-pipe with jet; or it forms an economical and efficient Fire Engine.

A is the suction pipe, and the water is delivered to any elevation through the pipe B, or at the nozzle of the three-way cock, C.



(No. 503.) THE IMPROVED THREE-WAY COCK.

The Improved Three-way Cock to bolt to the flange of the delivery outlet, is an important addition to the California Pump, and much increases its usefulness, as will be seen on reference to the above engraving. The vertical outlet is screwed for a wrought-iron rising main, the other for a hose union. There is a hook on the spout for carrying a bucket when the hose is removed. The prices annexed are with lever handle and hose union complete.

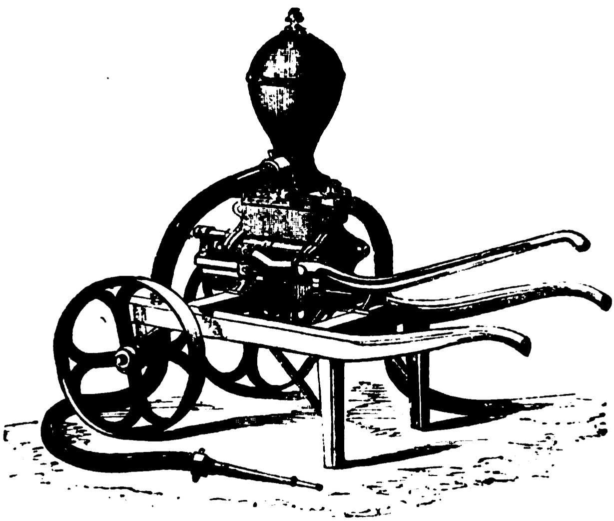
(No. 502.) CALIFORNIA PUMP (*continued*).

PRICES :—

Pump only, on Plank without the Three-way Cocks or Pipes, or Elbows.

Barrels.	Approximate Quantity. Galls. per hour.	Pump only. Price.	Three-way Cock. No. 503.
		£ s. d.	£ s. d.
2½ per bore	360	4 0 0	18 0
3 ,,	600	5 0 0	1 0 0
4 ,,	1,020	6 10 0	1 4 0
5 ,,	1,620	8 0 0	
6 ,,	2,400	10 10 0	

Extra Handles, 5*s*. each.



(No. 504.) CALIFORNIA BARROW PUMP,

On two wheels, complete with brass unions and one handle.

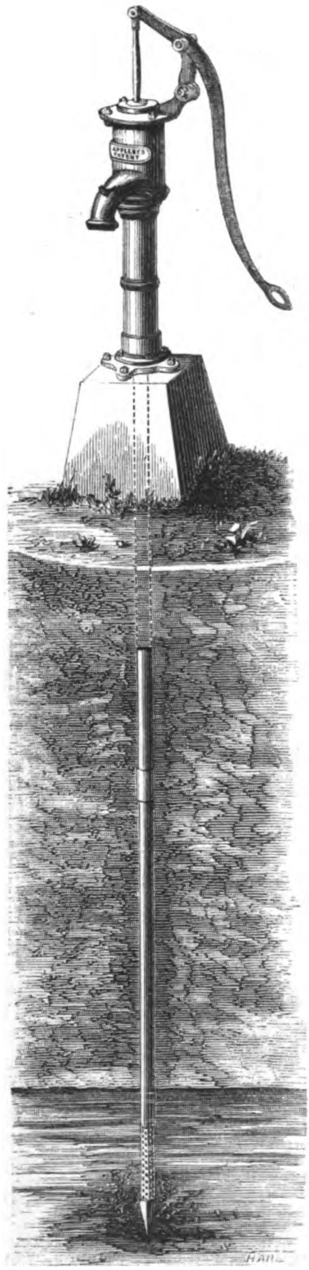
Barrel	2½	3	4	5	6 inches.
Price	6*l.*	7*l.*	8*l.* 10*s.*	10*l.*	13*l.*

Prices for the same Pump, but *without* the Barrow :

4*l.* 10*s.* 5*l.* 10*s.* 7*l.* 8*l.* 10*s.* 11*l.*

Extra Handles, 5*s.* each.

For prices of Hose Pipes, and other fittings for Pumps and Fire Engines, see pages 177 to 180.



NORTON'S
PATENT TUBE WELLS
AND
APPARATUS.

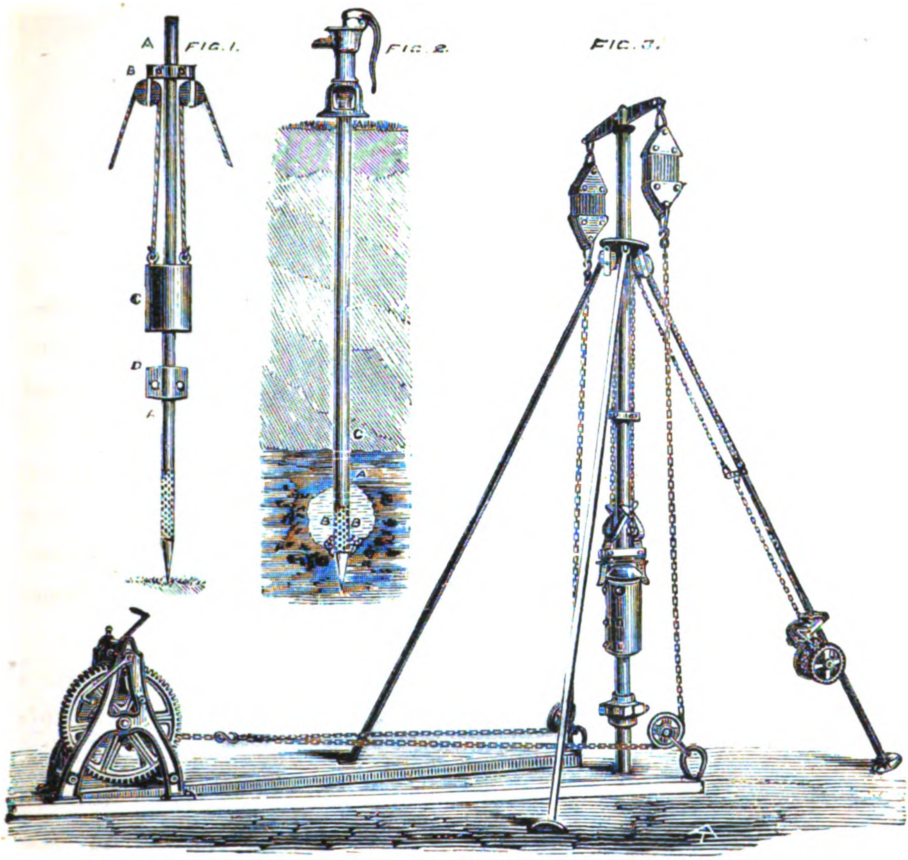
THE object of this invention is to afford facilities for testing, and obtaining water quicker, more pure, and cheaper than by the expensive and tedious process of well-sinking.

By this system water can be obtained in all cases where the ordinary processes of Sinking or Boring would be successful, and in many cases where those processes would fail, such as in quicksand, &c.

Where a large supply of water is wanted, a number of Tubes are driven, and coupled together at the top, so that an almost unlimited quantity may be obtained. The great ease with which these Wells are put into operation will recommend them where a temporary supply is required, or where first cost is an object.

For DEEP WELLS—that is, where the water does not rise within lifting distance, or say 25 feet (at the most) from the surface—it is necessary to place the working barrel and clack valve below the surface, and not more than 10 or 20 feet from the water.

This invention is an easy, cheap, and expeditious system of obtaining water *from a water bearing strata*, but it has no pretension of producing water unless it already exists in the strata.



PATENT TUBE WELLS AND APPARATUS—*continued.*

The apparatus for sinking or lowering the Patent Tubes is simple and easily worked, as will be seen from the engravings, and which were fully described in the "*Engineer*" newspaper of March 20, 1868.

Figure 1 represents the "monkey" or ram, used in sinking the USUAL size of tubes; and Figure 3 is generally used for the larger sizes of tubes. The Apparatus, Figure 1, is £25 and is not sent out with less than 5 Wells. It is, however, applicable for sinking any number of Wells.

Prices of Patent Tube Wells, including a 3-inch Appleby's Patent Pump with conical valves, for Top of Well, as shown at page 140:—

Patent Well Tube, 1¼ inch diameter, and Pump.

Depth	15	20	25	30 feet.
	£6 10 0	£7 10 0	£9 0 0	£10 10 0

If with the *ordinary* Pump, as shown in Fig. 2, 10*s.* less for each size.

Patent Sand Tubes for 1¼ inch Wells, £2 extra.

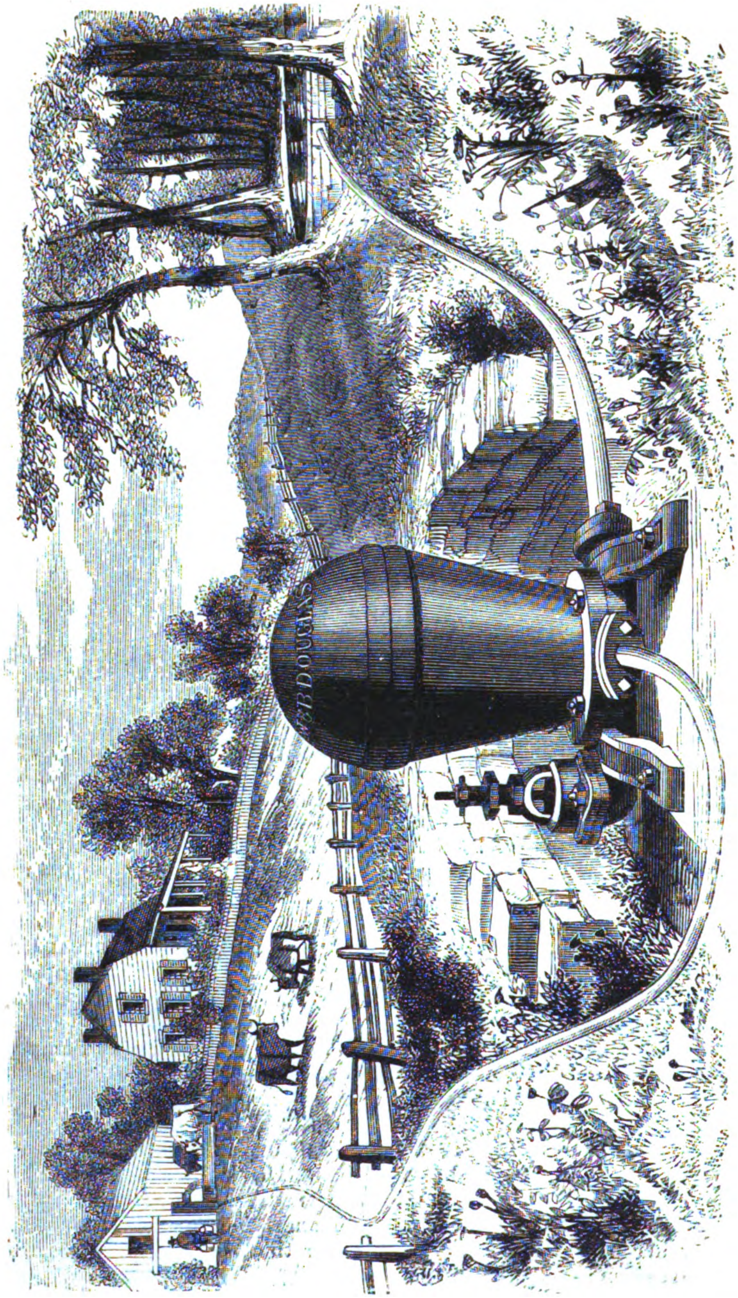
Special estimates are given for Wells of 2 in. and 3 in. diameter.

In making inquiries it is necessary to answer the following questions before estimates can be given:—

1st.—At what depth from the surface is water usually found in the district where Wells are required?

2nd.—What is the nature of the strata from the surface to where water is found?

3rd.—How many Wells, and what supply of water per hour is required?

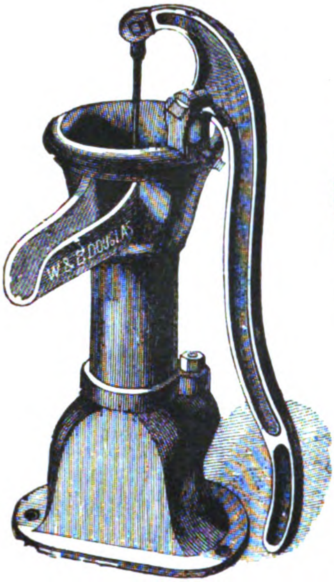


THE HYDRAULIC RAM SHOWN IN OPERATION.

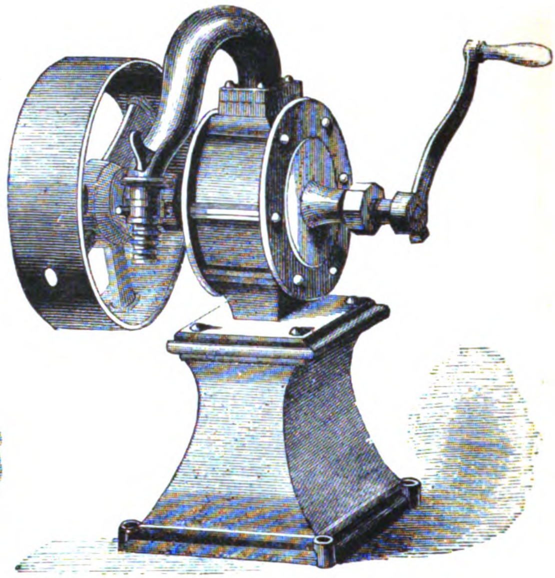
The Illustration on the opposite page shows the American Hydraulic Ram fixed and in operation, the object being to force a portion of the water from a spring or brook to any required distance or elevation. The height of fall or head of water *should not be less* than 8 or 10 feet, and the pipe which supplies the water from the stream to the Ram, as shown on the right side of the engraving, should be about twice the size of the delivery pipe which is shown in the front. The positions in which these Rams are required vary so much, that it is necessary to give all possible information to enable an engineer to calculate the size required for performing a given amount of work, or whether the "Ram" is applicable for the situation. The approximate prices of these Rams are as follows:—

	£	s.	d.
No. 2, of suitable capacity for a spring or brook which furnishes 3 quarts to 2 gallons per minute	1	12	0
3. Ditto, 1½ „ to 4 „ „	2	0	0
4. Ditto, 3 „ to 7 „ „	2	8	0
5. Ditto, 6 „ to 14 „ „	3	12	0
6. Ditto, 12 „ to 25 „ „	7	4	0

The Hydraulic Rams made in England are on a similar principle, but they are more compact, stronger, and, although a little more expensively got up, they are considered more durable.



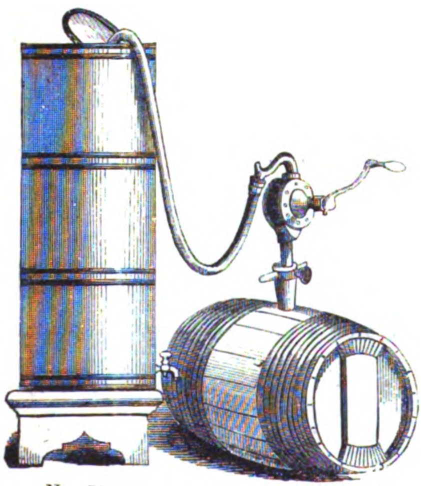
No. 505.



No. 506.

(No. 505.) AMERICAN PITCHER SPOUT PUMP.

2¼ in. Bore,	for ¾ or 1 in.	Wrought suction	. . . .	Price 16/0
3 ,,	,, 1 or 1¼ ,,	,, ,,	. . . . .	,, 18/0
3½ ,,	,, 1¼ or 1½ ,,	,, ,,	. . . . .	,, 20/0
4 ,,	,, 1½ or 1¾ ,,	,, ,,	. . . . .	,, 22/0



No. 507

(No. 506.) AMERICAN ROTARY HAND OR POWER PUMP.

Will lift 25 feet, and force to any required distance.

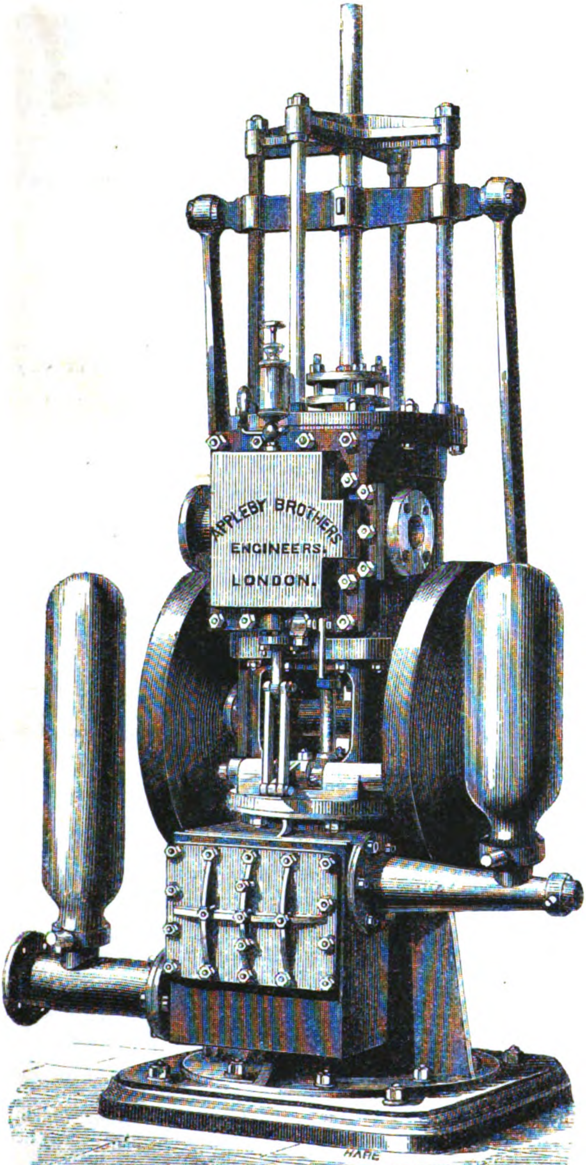
5½ in. diam. Pump, for 1 in. pipe £5 0s. 0*d*.
8¼ ,, ,, 1½ ,, 10 0 0

(No. 507.) AMERICAN ROTARY BARREL PUMP.

For pumping water, oil, or any liquid from Casks, into Cans or Tanks.

Price, with the Patent Barrel attachment £3 16*s*. 0*d*.

DIRECT ACTING STEAM PUMP OR FIRE-ENGINE.



For pumping large quantities of water for Factories, Railway Stations, Public Works, Town supply, &c. as well as for use as Fixed or Floating Steam Fire-engines; the working parts are principally of steel, and the crank plates are made to balance the piston, cross-head and rods.

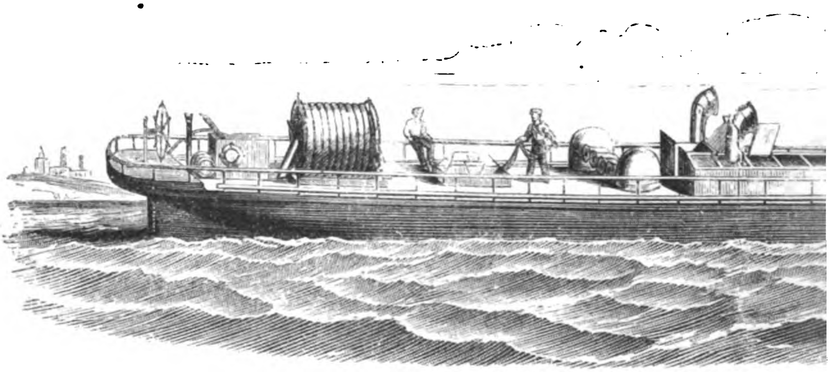
The Pump is an Appleby's Double-acting Pump, delivering the full capacity of the barrel at both the up and the down stroke; and when required for use in sea-water the whole of the Pump, valve-plates, guards, covers, glands, piston, piston-rod, bolts and nuts, and all parts coming in contact with salt water are made of hard gun-metal; for pumping fresh water the barrel is usually made of iron, and the valves &c. of gun-metal.

The engraving represents an Engine fixed on board the "Mystery,"* which was designed to answer the double purpose of a Steam-tug and floating Steam Fire-engine. It occupies a space of 3 feet square by 8 feet high, and takes the steam from the boat's boilers. With a pressure of 25 to 30 lbs. per square inch, the Pump throws 500 gallons of water per minute to a height of 150 feet through a 1⅞ in. nozzle. The Pump is 8½ inches diameter by 14 inches stroke and is made entirely of gun-metal, the suction-pipe is of copper, 5 inches diameter, and the delivery-pipe is 5 inches tapering to 2½ inches diameter, and fitted with hose-unions as used by the London Fire Brigade, and there is a large copper air-vessel on both the suction and delivery-pipe.

These Pumps are made of various sizes.

All applications for prices should be accompanied by particulars of the work to be done, the boiler pressure and the nature of the liquid to be pumped.

* See the *Illustrated London News*, Nov. 2, 1867.



FLOATING STEA

In 1830 Braithwaite constructed the first Land Steam Fire Engine that was used in London; he made several which were exhibited at various public trials, but could not succeed in bringing them into general use.

The next attempt to apply steam for the working of fire engines was made for the London Fire Engine Establishment, which was not instituted till some time after Braithwaite's endeavour to introduce Steam Fire Engines. In 1852 they had one of their large hand-worked floating fire engines altered so as to work by steam instead of manual power. The engine having been constructed by Tilley, the alterations were entrusted to and carried out by his successors, Shand, Mason & Co. (*See* Illustration above.)

In the same year the first American Land Steam Fire Engine was constructed in New York.

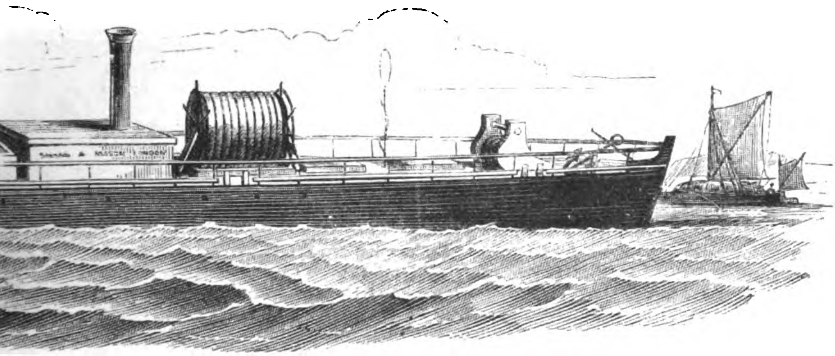
The success which attended the above-mentioned alteration, and the great advantage which resulted from working by steam instead of manual power, induced the London Fire Engine Establishment to have an entirely new Floating Steam Fire Engine constructed for them, and in 1855 they invited tenders with designs. The experience gained by the above-mentioned alterations enabled S. M. & Co. to compete successfully on this occasion, and their design was adopted.

It consists of two distinct direct-acting engines and pumps placed horizontally one on each side of the boat, with a boiler to each, so arranged that each boiler will work either or both engines if required. The pumps are readily disconnected from the steam engine, which also works one of Appold's Centrifugal Pumps for propelling the vessel by the ejection of water from the sides, either towards the head or stern, by means of valves which work independent of each other on each side of the vessel. There are four outlets on the deck of the vessel to which the hose is attached. It will throw 2,000 gallons of water per minute to a height of 160 feet.

The same manufacturers have lately constructed one for the Council of India, for use on the river Hooghley, at Calcutta, capable of delivering 3,000 gallons of water per minute. The engines, when disconnected from the pumps, work the screw propeller, with which the vessel attains a speed of 13 miles an hour. A full description, with illustrations, is given in the *Engineer* of the 5th April, 1867.

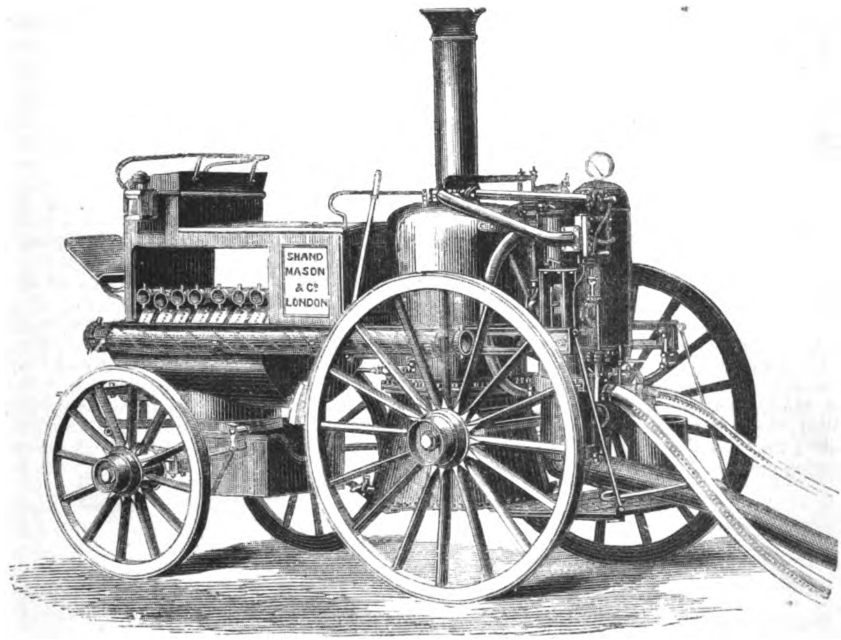
In 1858 the same makers completed the first Land Steam Fire Engine which had been made since Braithwaite's, which was tried several times in public in London, and afterwards sold and sent to St. Petersburgh; they also constructed two more in the following year, one of which the London Fire Engine Establishment took on hire in 1860 for one year; this proved so advantageous that they purchased the fourth engine made by the same firm. This, with one of the two made in 1859, were the only Land Steam Fire Engines at the great fire in Tooley Street in 1861.

At the Great Exhibition, 1862, there was a Steam Fire Engine exhibited by a manufacturer in New York, which was worked publicly at Messrs. Hodges' Distillery at Lambeth. Messrs. Merryweather & Son placed their first Steam Fire Engine in the Exhibition in 1862, which, like the one exhibited by Shand & Mason, was not in time for the opening, and consequently neither of these were eligible to compete for prizes.



FIRE ENGINE.

The London Metropolitan Fire Brigade have adopted them fully, and they are now used in many large towns, both in England and foreign countries, very satisfactorily, and by all the Volunteer Fire Brigades in the neighbourhood of London, where s team has been adopted.



VERTICAL STEAM FIRE ENGINE.

At the trials at the Crystal Palace in 1863, Shand, Mason & Co. adopted their present form of the Patent Vertical Steam Fire Engine, which there gained for them the principal prize of

£250 for an Engine weighing under 30 cwt., as also the second prize of £100 for Engines weighing over 30 cwt. but under 60 cwt.

The boiler is of the vertical tubular description, fitted with all necessary safety valves, gauges, &c. The steam cylinder is placed directly over the pump, which is of the bucket and plunger principle, and both firmly attached to the boiler vertically. The pistons of the steam engine and pump are connected by two rods, and are direct acting; the length of the stroke is limited by means of a crank with fly-wheel (so that no damage can arise to the cylinder covers) which also work the slide valve and feed-pump; the whole mounted on a strong wrought-iron frame with fore-locking carriage, springs, and four high wheels, pole, and sway-bars for a pair of horses, and driving-seat and footboard. Steam of good working pressure can be obtained in less than ten minutes from lighting the fire, cold water being used.

The construction of the above Engine is exceedingly simple, and free from all peculiarities with which engineers are not supposed to be practically acquainted in the usual course of business, so that should anything require adjusting, it might be done by any engineer; it is readily worked by any person of ordinary intelligence after a few trials; the whole of the works are easily accessible, and can be moved by the fly-wheel to see that the Engine is in order without the necessity for raising steam for that purpose, and the hose and suction-pipe are placed so as to be quite clear of all the machinery when in action; it can be worked through two lines of hose, which can be worked separately or together by means of a valve so arranged that both outlets cannot be closed at the same time.

These Engines have been tested by Messrs. John Penn and Son, and were subsequently found to exert one horse power for every 112 lbs. weight of engine, the carriage, &c. included. See *Engineer* newspaper, 29th July, 1864.

As an instance of the greatly diminished cost of working these engines as compared with the old hand-worked engines, at the large fire at Beal's Wharf in Tooley Street, Oct. 30, 1866, eight of these Engines worked for twelve hours continuously at an expense of £5 5*s*., projecting in that time 6,000 tons of water. The number of manual-power engines required to produce the same result would have been eighty, and the expense for labour and refreshment would have cost £600, showing a balance in favour of steam of £594 15*s*.

THE HORIZONTAL STEAM FIRE ENGINE.

These Engines are made with both single and double cylinders; they are constructed in every respect on the same principle as the Vertical, but have the steam cylinders and pump placed horizontally, and are larger. Those with single cylinder are used with great success at Moscow and St. Petersburg, and the double cylinder Engines of this class are now adopted by the Admiralty, and are stationed at Her Majesty's Dockyards at Pembroke and Sheerness. They are mounted on springs, and axle, and high wheels, and are drawn by horses at considerable speed. They are also made without the travelling portion, having only the boiler and engine, fixed to a wrought-iron base, so that they can be placed on board a boat or steam tug, and they are also supplied without the boiler and fixed on a tug-boat, using the boiler belonging to the boat, the Engine being modified to suit the pressure at which it is worked; these have been applied, the former in the Victoria London Docks, and the latter in the Grand Surrey Canal Docks; they can also be applied in a similar manner to fixed machinery on extensive manufacturing premises.

PRICES OF STEAM FIRE ENGINES.

HORIZONTAL STEAM FIRE ENGINE.

As used by the London Fire Brigade, Russian Government, Bombay and Baroda Railway, &c. &c.

	SINGLE.	DOUBLE.
Quantity of water pumped per minute at a moderate rate of working	500 Gallons.	1000 Gallons
Diameter and height of jet	One 1⅜ in. jet 180 feet high	Two 1⅜ in. jets 180 feet high
Price of engine complete, with pressure gauges, feed pump, Giffard's injector, set of spare valves, spare water-gauge glasses, suction strainer, set of nut wrenches, hose and suction wrenches, screw wrench, stoking irons, two long and one short branch pipes, two branch pipe staves, five jet pipes, a pair of carriage lamps, an engine lamp, tube brushes, oil and tallow cans, pole and sway bars for horses, and every article complete, excepting hose and suction pipes	£650	Including, in addition, one small branch pipe, a double connecting screw, 20 feet large hose and couplings, and a large branch pipe, with two jet pipes £850
Best India rubber suction pipe	10/0 per foot	10/0 per foot*
Gun-metal couplings for each length of do. including fixing	32/0 per pair	32/0 per pair
Best copper rivetted leather or India rubber hose, in lengths of 40 feet, with couplings, hand loops, and straps complete	£7 12/0 per length	£7 12/0 per length
Packing and delivery at docks in London . . .	£14	£16
Extra for improved lever break	£13	£15
Weight of engine without coals, water, hose or suction . . . . about	4928 lbs.	6496 lbs.
Outside dimensions for shipment . . about	11 ft. × 5 ft. 10 in. × 7 ft. 8 in.	11 ft. 2 in. × 6 ft. 8 in. × 7 ft. 7 in.

* This engine requires two lines of suction pipe.

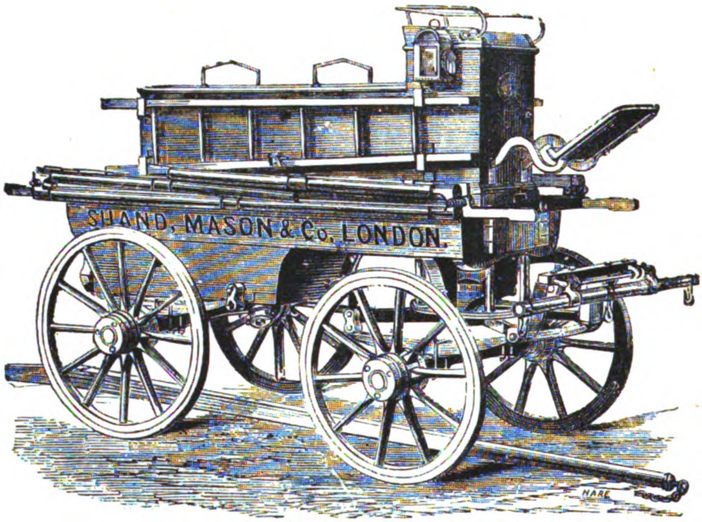
VERTICAL STEAM FIRE ENGINE.

As used by the London and Dublin Fire Brigades, various European Governments, &c.

	SMALL.	MEDIUM.	LARGE.
Quantity of water pumped per minute at a moderate rate of working	300 Gallons.	400 Gallons.	750 Gallons.
Diameter and height of jet	One 1 in. jet 150 feet high	One 1¼ in. jet 170 feet high	Two 1¼ in. jets 180 feet high
Price of engine complete, with pressure gauges, feed pump, Giffard's injector, set of spare valves, spare water-gauge glasses, suction strainer, set of nut wrenches, hose and suction wrenches, screw wrench, stoking irons, two long and one short branch pipes, two branch pipe staves, five jet pipes, a pair of carriage lamps, an engine lamp, tube brushes, oil and tallow cans, pole and sway bars for horses, and every article complete, excepting hose and suction pipes	£400	£600	Including the same additions as in the double horizontal steam fire engine £800
Best India rubber suction pipe	7/6 per foot	10/0 per foot	15/0 per foot
Gun-metal couplings for each length of do. including fixing	30/0 per pair	32/0 per pair	40/0 per pair
Best copper rivetted leather or India rubber hose, in lengths of 40 feet, with couplings, hand loops, and straps complete	£7 12/0 per length	£7 12/0 per length	£7 12/0 per length
Packing and delivery at docks in London . . .	£10	£12	£14
Extra for improved lever break	£9	£11	£13
Weight of engine without coals, water, hose, or suction . . . . about	313[illegible] lbs	3696 lbs.	4928 lbs.
Outside dimensions for shipment . . about	9.6 × 5.6 × 6.4	10.2 × 5.8 × 6.6	11 ft. × 5 ft. 10 in. × 7 ft.

Land Steam Fire Engines are also made without wheels, axles, and carriage, ready fitted for placing in boats to serve as Floating Steam Fire Engines, at a reduction of 10 per cent. from the fore going prices.

IMPROVED LONDON BRIGADE HAND FIRE ENGINE.



Is the most complete hand-worked fire engine that is made, and is especially adapted for municiple, country, volunteer, and private fire brigades; it is light yet strongly built. The works are of the best description, being fitted with metallic valves, two gun-metal cylinders and pistons, copper suction and delivery air-vessels, and are fixed in a strong well-seasoned oak cistern, with side pockets to carry suction and branch pipes, and a box placed over the cistern to carry hose and implements, with driving-seat and footboard, wrought iron forelocking carriage and draghandle, with pole and sway bar for a pair of horses, springs and high wood spoke wheels for rapid travelling, draws water either through suction-pipe from pond, rivers, &c., or from cistern of the engine &c., and delivers on either or both sides. Each engine is provided with a copper branch pipe, having gun-metal screw to attach to hose, and boss to take jet pipe, two jet pipes, a copper strainer with gun-metal screw to fix on end of suction-pipe, a wrench for suction air-vessels, two hose wrenches and a screwdriver with shifting handle.

These engines are adopted by the Metropolitan Board of Works, the Volunteer Brigades in the neighbourhood of London, and almost all the large towns and districts in England, the various Insurance Offices, Her Majesty's War Department, Admiralty, Council of India, the Colonies, and in many foreign countries.

PRICES.

For	46	men to pump	218	gallons per minute	150	feet high,	price	£150.
,,	36	,,	174	,,	140	,,		135.
,,	30	,,	134	,,	130	,,		120.
,,	22	,,	100	,,	120	,,		110.
,,	16	,,	68	,,	100	,,		100.

COUNTRY BRIGADE FIRE ENGINE.

In small country towns and thinly inhabited rural districts, where it is necessary to have a Fire Engine, which may be drawn by a horse at considerable speed, the expense of purchasing a London Brigade Engine is frequently too heavy a tax on the inhabitants. The Country Brigade Engine, which is equally powerful when worked by the same number of men as the London Brigade Engine, has the exterior arrangements made so as to be less expensive, and consequently more within the means of such purchasers. The works are similar to the London Brigade Engine, and it is fitted with locking carriage springs, wrought iron axles, shafts for one horse, four wood spoke wheels, and driving seat and footboard; will carry men and travel at considerable speed.

PRICES.

For 30	men to pump	134	gallons per minute	130	feet high,	price	£105.
,, 22	,,	100	,,	120	,,		90.
,, 16	,,	68	,,	100	,,		75.

FACTORY FIRE ENGINE.

Where a powerful Fire Engine is required for extensive premises, such as railway stations and works, ship building and timber yards, factories, and extensive government works, docks, &c. and is not required to be drawn by horses, this Engine is in much request, being adopted by the British Admiralty, and at the London, Brighton, and the South Coast, the South Eastern, and other railway stations and works. They are similar to the London Brigade Engine, but without springs, gear for horse, driving seat and footboard, being drawn by means of a drag handle.

PRICES.

For 46	men to pump	218	gallons per minute	150	feet high,	price	£125.
,, 36	,,	174	,,	140	,,		110.
,, 30	,,	134	,,	130	,,		95.
,, 22	,,	100	,,	120	,,		85.
,, 16	,,	68	,,	100	,,		73.

MANSION FIRE ENGINE

Is designed for the protection of private mansions, small villages, railway stations and works, manufacturing and other premises, where it is required to be taken to short distances only, being made very light for that purpose. The pumps are equally powerful as those of any other classes of Engine which are worked by the same number of men. It is similar to the Country Brigade Engine, but without springs, shafts, driving seat, and footboard, and is much used for the above-mentioned purposes in all parts of England, and in many foreign countries.

PRICES.

For 30	men to pump	134	gallons per minute	130	feet high,	price	£90.
,, 22	,,	100	,,	120	,,		75.
,, 16	,,	68	,,	100	,,		60.
,, 12	,,	55	,,	90	,,		45.
,, 8	,,	44	,,	80	,,		35.

METALLIC FIRE ENGINES, Nos. 1 and 2,

Are modifications of the Factory and Mansion Fire Engines, rendering them more suitable for use in tropical climates, by the substitution of copper instead of wood in the construction of the cistern, in which the works are fixed, rendering them impervious to the attacks of insects and the effects of the climate.

PRICES, No. 1.

For 30	men to pump	134	gallons per minute	130	feet high,	price	£105.
,, 22	,,	100	,,	120	,,		95.
,, 16	,,	68	,,	100	,,		85.

PRICES, No. 2.

For 30	men to pump	134	gallons per minute	130	feet high,	price	£95.
,, 22	,,	100	,,	120	,,		80.
,, 16	,,	68	,,	100	,,		70.
,, 12	,,	55	,,	90	,,		55.
,, 8	,,	44	,,	80	,,		45.

METALLIC FIRE ENGINE, No. 3.

Also much used for noblemen and gentlemen's mansions and premises of moderate size, and frequently as a superior garden engine in gardens of considerable extent, as it is readily worked by from two to four men, six men being the full number.

PRICE, No. 3.

For 6 men to pump 33 gallons per minute 70 feet high, price £20.

METALLIC FIRE ENGINE, No. 4.

For use in manufacturing and other large premises, where it is not required to run it out to fires in the neighbourhood, and where the expense of the other classes of Engines would preclude their adoption. It is well and strongly made, but of less expensive form and material.

PRICES, No. 4.

For 30 men	to pump	134 gallons	per minute	130 feet	high,	price	£60.
,, 22	,,	100	,,	120	,,		52.
,, 16	,,	68	,,	100	,,		45.

PATENT CURRICLE ENGINE.

Extensively used by the London Fire Brigade, the Council of India, and Country Fire Brigades. It is mounted on springs, and a pair of high wood spoke wheels, is extremely light of draught, and is readily drawn by a man or horse. It carries all appliances for extinguishing fire, forming a complete Fire Engine at very small cost.

PRICES, FOR HAND DRAUGHT.

For 22 men	to pump	100 gallons	per minute	120 feet	high,	price	£55.
,, 14	,,	68	,,	100	,,		45.
,, 8	,,	44	,,	80	,,		35.

PRICES, FOR HORSE DRAUGHT.

For 22 men	to pump	100 gallons	per minute	120 feet	high,	price	£65.
,, 14	,,	68	,,	100	,,		55.

IMPROVED PORTABLE FIRE PUMP.

Introduced by the London Fire Engine establishment a few years ago, since which time it has been constantly in use, and found of great service, many fires having been extinguished through its instrumentality.

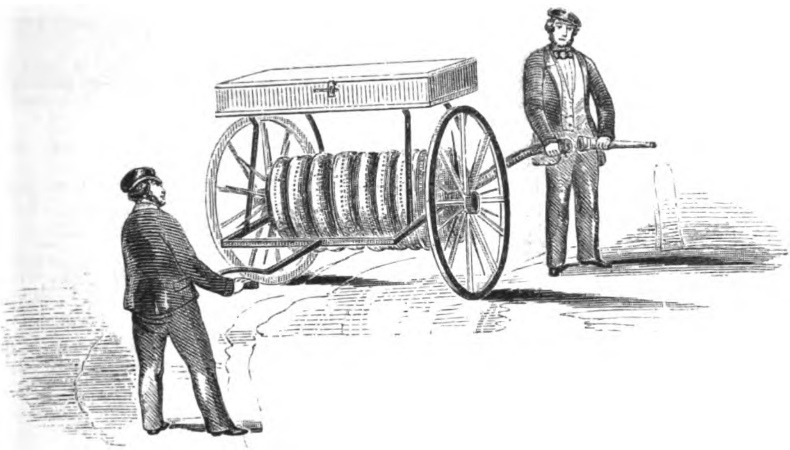
The air vessel, barrel, and valves, are entirely of brass, not liable to get out of order, and the whole can be kept in any convenient situation, ready for immediate use.

This Pump will force 6 gallons per minute, to a height of 30 feet.

Price, with 10 feet rivetted leather hose, swivel screws and jet pipe, 45/0.

Galvanized iron pail, with internal socket for reception of the pump, by which one person can work and direct the jet, 12/6.

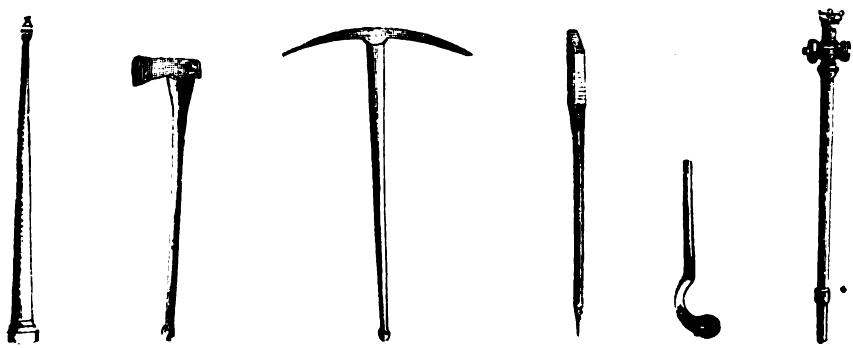
Additional for India rubber instead of leather hose, 4/2.



IMPROVED HOSE REEL.

The machine consists of a pair of high wood wheels and wrought iron axle. A reel to contain the hose, revolving on the axle but independent of it. Wrought iron frame-work fixed to the axle, forming a draghandle and support for the box. Box to contain stand-pipe, branch-pipe, and other necessary implements.

Price, complete, £11 10*s*. Constructed to contain 400 feet of leather, or 1,200 feet of canvas hose. If mounted upon springs, £4 extra.



(*a*) (*b*) (*c*) (*d*) (*e*) (*f*)

(*a*) Copper branch pipe with gun-metal jet-pipe, 20/0 to 30/0. (*b*) Fire axe, 7/6. (*c*) Pick axe, 5/6. (*d*) Crow bar, 5/0. (*e*) Hose Wrenches, each, 1/6. (*f*) Stand pipe with stop valve for street plugs, 72/0.

When kept ready for use, the whole of the hose is connected by the couplings into one length and coiled on the reel, a female screw being left outside, and all the implements are in their places in the box.

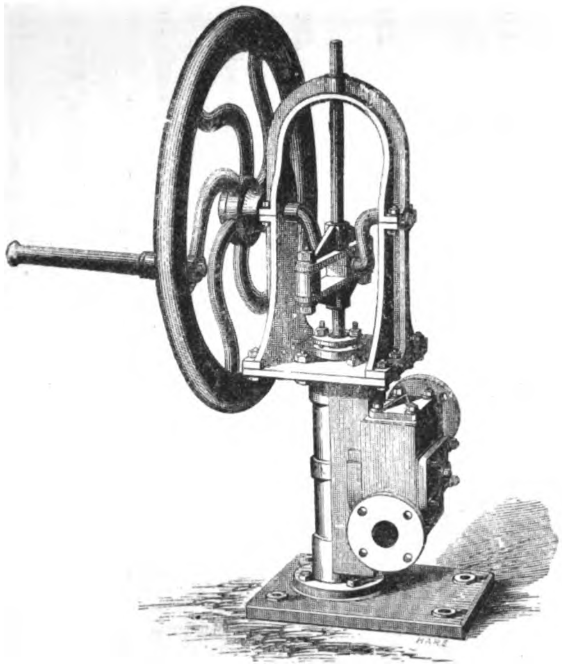
Upon an alarm of fire being given, run the hose reel by one or two men to the fire plug nearest to the premises on fire, connect the hose to the fire plug or stand-pipe, then move the machine as near the fire as convenient, the hose being uncoiled and laid on the ground by the reel in its progress; disconnect the hose at the nearest coupling, and attach the branch-pipe, when the whole is ready for the water to be turned on.

HOSE AND SUCTION PIPES.

The hose is of the best description, equal in quality to that which is supplied in large quantities to the Metropolitan Fire Brigade, and other principal brigades in England, Ireland, and foreign countries.

PRICES.								
Greatest number of men required to work each Engine	**46**	**36**	**30**	**22**	**16**	**12**	**8**	**6**
Copper rivetted leather hose per 40 feet length, with gun metal swivel screws, fixed with copper wire .	170/	160/	152/	134/	120/	102/	92/	89/
Patent woven canvas hose, per foot	1/2	1/	11*d.*	10*d.*	9*d.*	8¼*d.*	8*d.*	7*d.*
Ditto ditto, best quality ,, ...	1/9	1/6	1/4	1/3	1/2½	1/1	1/	11*d.*
Gun metal swivel screws for each length of canvas hose, including fixing with copper wire and a leather strap	25/	21/	18/	16/	14/	12/	11/	10/
Copper rivetted leather, or India rubber suction, per foot	12/	9/	7/	6/3	5/8	5/1	4/6	3/8
Gun metal swivel coupling screws, including fixing .	30/	25/	21/	18/	16/	14/	12/	11/

Leather hose is made in 40 feet lengths, woven canvas hose can be had in any length up to 400 feet, and is about one-fourth the weight and bulk of leather, it can be prepared to prevent rot at an expense of 1*d.* per foot.



No 13.

IMPROVED DOUBLE-ACTION LIFT AND FORCE PUMP.

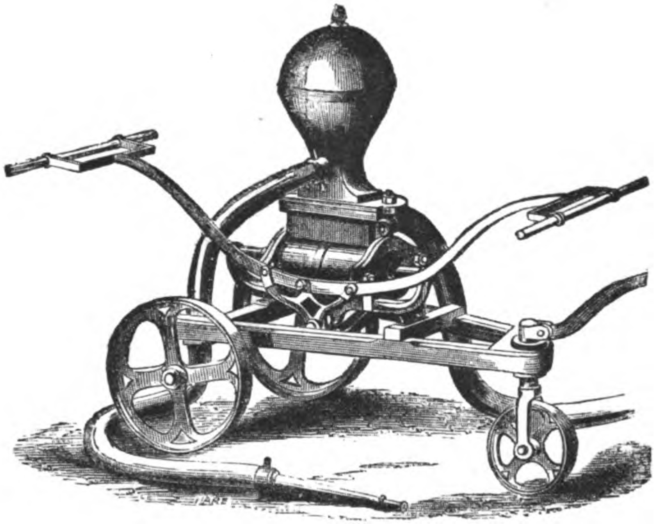
WITH ROTARY MOTION.

THIS Pump is fitted with iron frame or carriage, with wrought-iron crank, fly-wheel and two handles, slotted cross-head, with planed gun-metal slide-block, turned guide rod, turned and bored stuffing-box with gland, two patent oscillating conical valves for the suction, and two for the delivery, with doors to give free access to each valve-box.

Being on the *double-action* principle—namely, to raise water at both the up-stroke and down-stroke—one Pump is equal in capacity to *two single-action Pumps* of the same diameter

These Pumps are suitable for a great variety of purposes, either portable or stationary, and may be adapted for steam power by the application of a pulley at one end of the main shaft; or, if for ship's deck, they may be worked by a "chain pulley."

Bore of Barrel.	Stroke.	Price, with Iron Barrel bored.	Price, with Brass-lined internal Barrel, and Gun-metal Valves.	Gallons per hour, at 40 strokes per minute.
Inches.	Inches.	£ s. d.	£ s. d.	Gallons.
3	12	21 0 0	23 10 0	1,350
4	12	25 0 0	27 10 0	2,500
For steam power.				
6	12	30 0 0	33 0 0	5,250
8	14	40 0 0	44 0 0	11,500



THE CALIFORNIA FIRE ENGINE,

For Mansions, Farms, Dockyards, Factories, Warehouses, Ships, &c.

The 6 inch Fire Engine, worked by 4 or 6 men, at 35 strokes will throw about 50 gallons per minute upwards of 50 feet high from the branch-pipe.

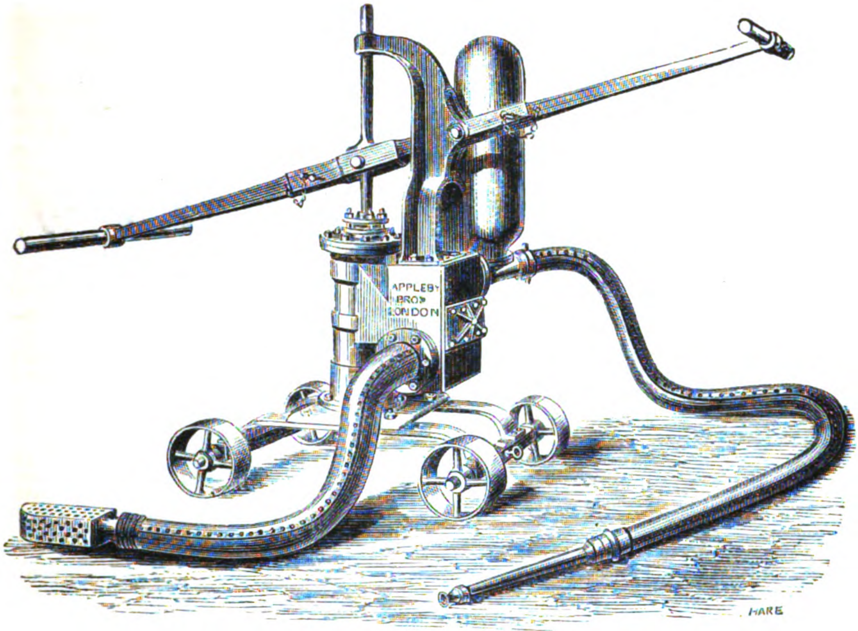
The Pump is mounted on 3 wheels, and is furnished with cross lever handles and copper piston rod.

	5-in. barrel.	6-in. barrel.
With Brass-lined barrel, Copper air-chamber and Copper piston rod.	£20 0*s.* 0*d.*	£23 0*s.* 0*d.*
With Brass-lined barrel, Iron air-chamber, and Copper piston rod.	£18 0*s.* 0*d.*	£21 0*s.* 0*d.*
With Iron barrel and air-chamber and Copper piston rod.	£16 0*s.* 0*d.*	£19 0*s.* 0*d.*

Fire Engine complete, ready for use, with 15 feet of copper-rivetted leather suction hose, with strainer, 46 feet of copper-rivetted leather delivery hose (or 40 yards of canvas ditto), brass couplings, copper branch pipe and nozzle for delivery, wrenches &c., boxes and hooks for tools, hose, &c.

Price for 5-inch engine, £29; and for 6-inch engine, £35.

For prices of Hose pipes and other fittings for Fire Engines, see pages 178 *and* 180



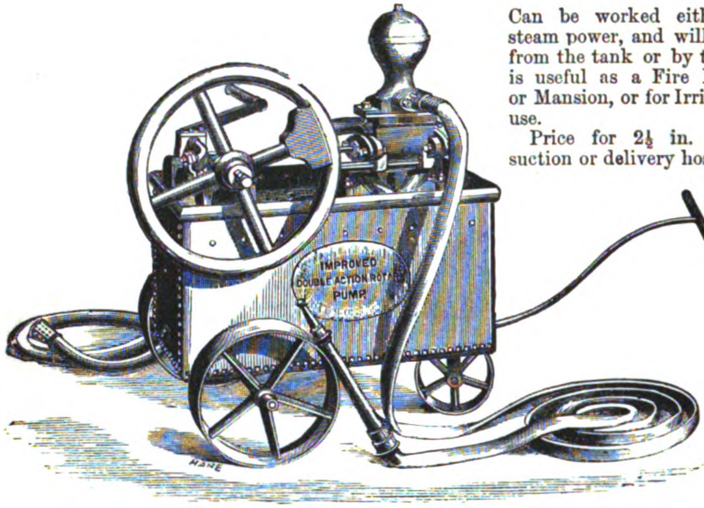
No. 15. PORTABLE DOUBLE ACTION FIRE ENGINE OR PUMP,

With bored barrel, doors for access to all the valves, wrought iron double lever handles, brass union hose screws for connecting the suction and delivery hose; the pump is mounted on a wrought iron stand, with four wheels.

Bore of Barrel.	Stroke.	Prices. Iron Barrel.	Prices. Brass Lined Barrel.	Approx. Gals. per hour, at 40 strokes per min.	Best Suction Hose, per ft.	Best Delivery Hose, per ft.	Iron Air Vessel on delivery outlet.
Inches.	Inches.	£ s. d.	£ s. d.	Gals.	s. d.	s. d.	£ s. d.
3	12	24 0 0	26 10 0	1350	4 6	2 6	1 5 0
4	12	29 0 0	31 10 0	2500	5 4	3 0	1 10 0
6	12	34 0 0	37 0 0	5250	5 9	3 6	2 0 0

		£ s. d.
Price for a FIRE ENGINE, AS SHOWN, with iron barrel, air vessel, 12 ft. of 2 in. best suction, with strainer, 40 ft. of 2 in. best delivery hose, union screws for connecting hose, branch pipe, and jet, complete for use. 3 inch Barrel	. . . .	36 0 0
4 inch Barrel. ditto ditto ditto	. . . .	42 0 0
6 inch Barrel. ditto ditto ditto	. . . .	47 10 0

IMPROVED PORTABLE DOUBLE ACTION ROTARY PUMP, OR FIRE ENGINE, ON IRON TANK AND THREE WHEELS



Can be worked either by hand or steam power, and will draw the water from the tank or by the suction hose; is useful as a Fire Engine for Farm or Mansion, or for Irrigation, or Garden use.

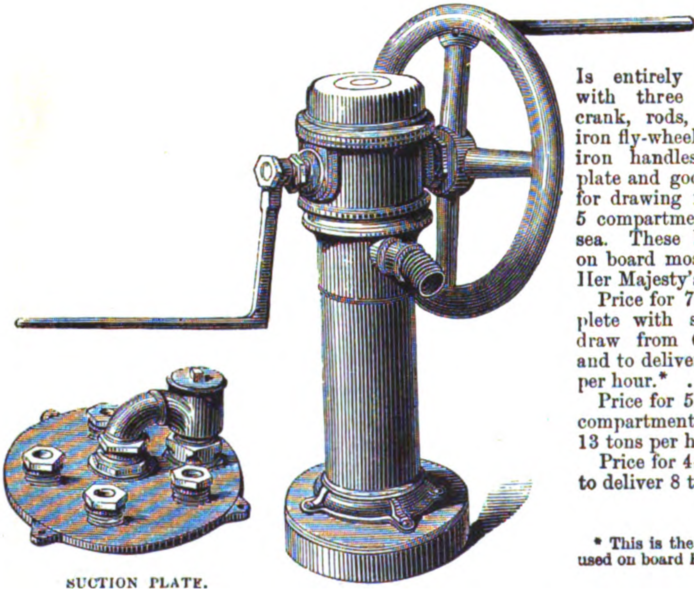
Price for 2½ in. Pump, without suction or delivery hose . . £11 5s.

Ditto 3 in. ditto, £12 10s.

Price for 2½ in. Fire Engine with 12 feet of suction and 40 feet of delivery hose, branch pipe and jet complete as shown, £20 10s.

Price for 3 in. ditto, ditto, £23 0s.

DOWNTON'S PATENT ROTARY SHIPS' MAIN PUMP OR FIRE ENGINE.



SUCTION PLATE.

Is entirely of gun-metal, with three buckets, treble crank, rods, slides, &c. cast-iron fly-wheel, and 2 wrought-iron handles; the suction plate and goose-neck is fitted for drawing from any one of 5 compartments, or from the sea. These Pumps are fitted on board most of the ships of Her Majesty's Navy.

Price for 7 in. Pump complete with suction plate to draw from 6 compartments, and to deliver 21 tons of water per hour.* . . . £62 10s.

Price for 5½ in. ditto, for 6 compartments, and to deliver 13 tons per hour. . £50 0s.

Price for 4½ in. ditto, ditto, to deliver 8 tons per hour. £37 10s.

* This is the size most generally used on board Her Majesty's ships.

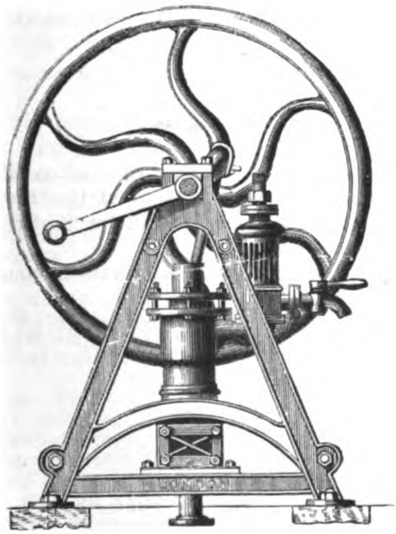
No. 27.

NEW PORTABLE DOUBLE-ACTION RAM AND BUCKET FORCE-PUMP, FARM FIRE-ENGINE, AND IRRIGATOR.

THIS powerful Force Pump is capable of discharging about 15 gallons per minute, in a constant stream, to an elevation of 40, or 50 feet; the supply may be drawn from a depth of 20 to 25 feet. This is the best, simplest and most portable Pump yet invented, and at a most moderate cost. It is complete on Wood Barrow with Iron Wheels.

Bore of Barrel.	Plunger.	Gals. per Hour.	Price with turned Iron Ram and Brass Bucket.	Best Suction Hose per Foot.	Vulcanised India Rubber delivery Hose, per Foot.
			£ s. d.	s. d.	s. d.
3½ inches.	2½ inches.	600	5 15 0	3 0	1 11
4½ ,,	3 ,,	900	7 10 0	3 4	2 2

Patent Wove Canvas Delivery Hose, lined with Linen, may be had at *7d.* and *8d.* per foot; but it is not nearly so good as India-rubber.



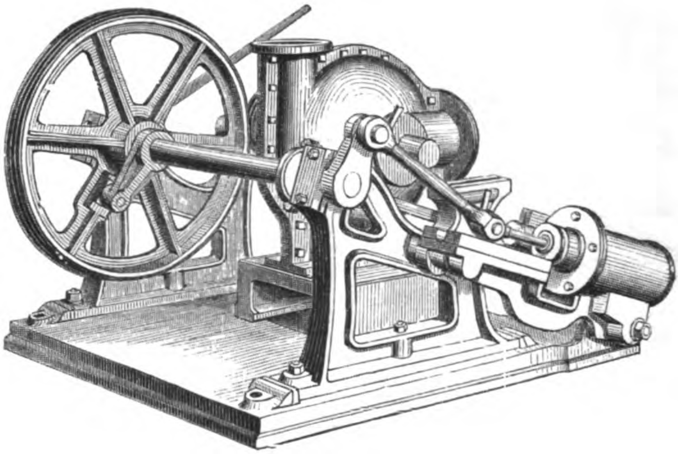
No. 28.

IMPROVED DOUBLE-ACTION FORCE-PUMP,

Mounted on cast-iron frame with fly-wheel, for hand or power. This is an extremely simple and durable form of Pump, having but *one working barrel*: it is fitted with gun-metal plunger and bucket, and delivers at BOTH the UP and DOWN STROKE, discharging the same quantity as ordinary *Double Barrel* Pumps. It is suited for filling Tanks at Railway Stations, or in Private Establishments, &c. The Pump, as shown, will draw from a depth of about 25 feet from ground-line to water-level in well, and will force to any reasonable height or horizontal distance. It is equally applicable for *deep wells*, fixing the working barrel down the well about 15 or 20 feet above the water-level. Prices as below, with Brass Plunger, Gland, and Bucket, finishing with flanged inlet and outlet for suction and delivery pipes:—

Bore of Barrel.	Diameter of Plunger.	Gals. per Hour at 30 to 35 Strokes per Minute.	Price for Manual Power.
4½ inches.	3 inches.	500 to 700	£20 10 0
5 ,,	3½ ,,	700 to 900	22 10 0
5½ ,,	4 ,,	900 to 1200	28 10 0

Air-vessel and Draw-off Cock extra.



DIRECT-ACTING STEAM-ENGINE AND CENTRIFUGAL PUMP COMBINED.

THE Pump is fixed upon a strong base plate centrally between the side frames, and the suction and delivery pipes are placed in any position to suit special requirements, whatever they may be. The Engine is attached to one of the side frames required for carrying the bearings in any arrangement of Centrifugal Pumps, and the Pump is driven by the Patent Frictional Gearing. By this simple contrivance the whole machine is self-contained, the use of a separate Engine is dispensed with, and the wear and tear of straps is avoided.

The driving-wheel can be instantly thrown in or out of gear with the pinion on the pump-shaft by means of the lever provided for that purpose, and the Engine is then available for driving machinery of any description when it is not required for pumping, and the arrangement is such that when the Pump is removed, a winding barrel can be put in, and the Engine can be used as a Steam Crab or Winch, or as a Hauling Engine.

The Boiler is placed in any convenient position, and the steam is taken to one or more pumps as required.

Estimates forwarded on application (accompanied by full particulars of the work to be done), for larger pumps, or for this arrangement of machinery, with boiler complete, and the whole mounted on travelling wheels.

Price List.

Pump to raise per m. in Galls.	Engine with Cylinder	Engine with Stroke.	Price of Engine and Pump complete as shown. £ s. d.
150	5 inches.	10 inches	75 10 0
300	7 "	10 "	93 10 0
500	8 "	10 "	105 10 0
700	9 "	12 "	144 0 0
1000	10 "	12 "	156 0 0
1500	12 "	12 "	170 0 0

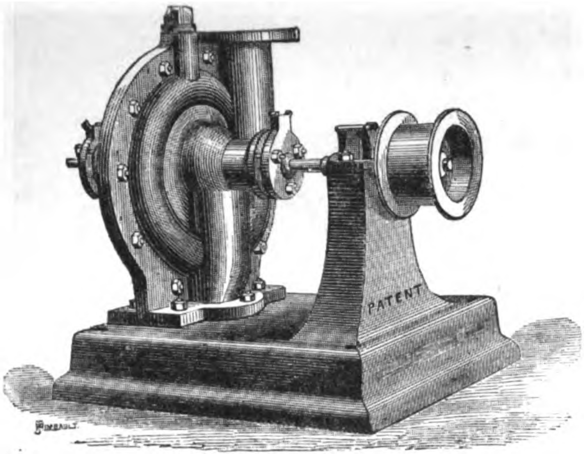
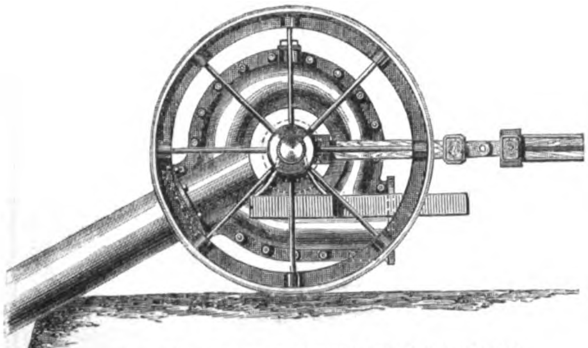


FIG. 1.

M



(FIG. 2.) PATENT CENTRIFUGAL PUMP.
Mounted on Two-wheel Carriage.

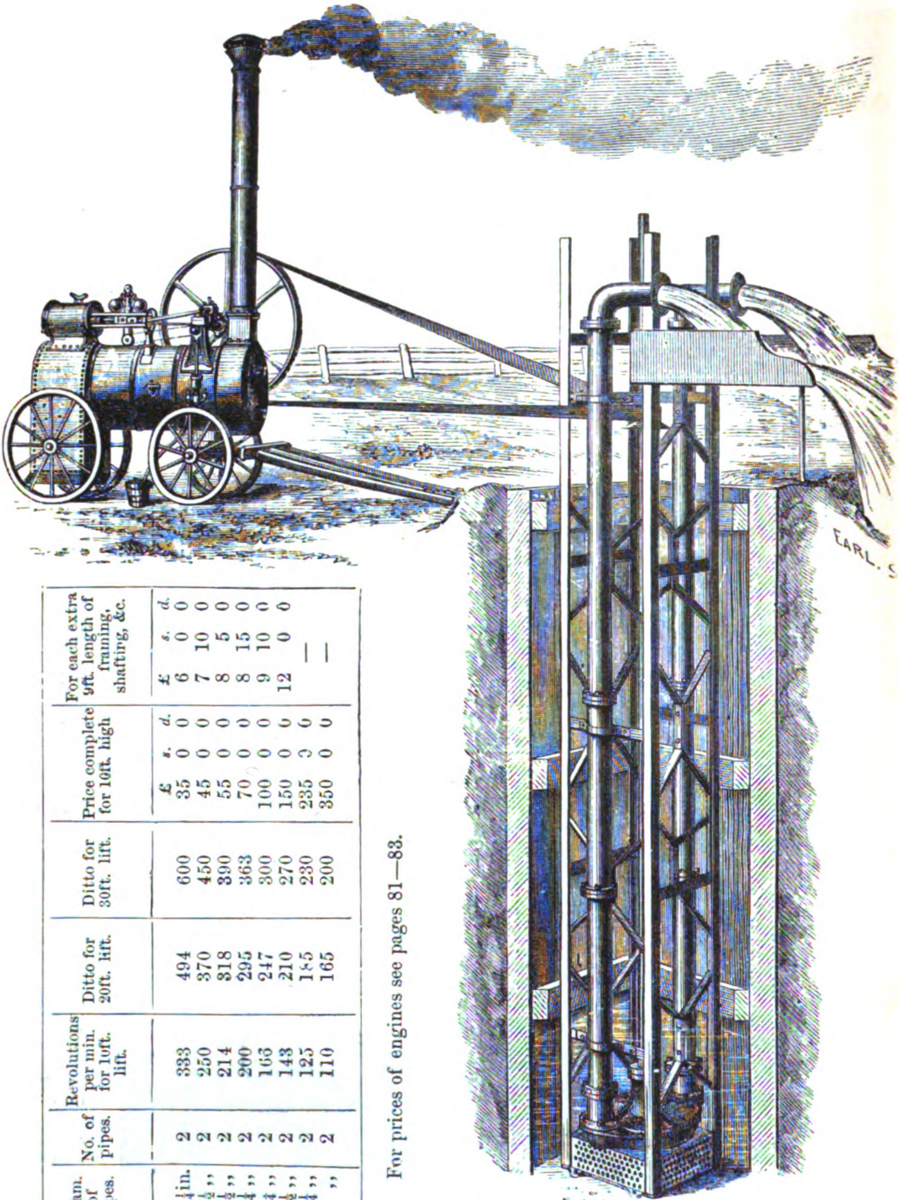
GWYNNE'S PATENT CENTRIFUGAL PUMPS.

No. of Pump.	Diameter of Suction and Discharge Pipes.	*Quanity of Water discharged per Minute, in Gallons.	Horse Power to work the Pump one foot high.	Size of Driving Pulleys.	FIG. 1. Price of Pump complete.	FIG. 2. Price of Portable Pump, mounted on Two-wheel Carriage.	Price of Portable Pump, mounted on Four-wheel Carriage.	Price of Footvalve, including wrought iron Grating.	Price of Cast Iron Flanged Pipes in 9 feet lengths, with bolts, nuts, and elastic packing, per foot.	Price of Wrought Iron Flange Pipes, in 9 feet lengths, with bolts, nuts, & elastic packings, per ft.
	in			dia. width	£ s.	£ s.	£ s.	£ s.	s. d.	s. d.
1	1	12 to 25	·005 H.P.	3×3½	8 0	13 0	12 0	1 4		1 0
2	2	44 to 80	·018 H.P.	4×3½	10 0	16 0	14 10	1 10	1 0	1 11
3	3	75 to 120	0·030 H.P.	4×4	12 0	18 0	16 16	1 16	1 9	2 8
4	4	200 to 400	0·078 H.P.	5×4½	14 0	21 0	19 12	2 2	2 1	4 8
5	5	300 to 600	0·13 H.P.	6×6	20 0	27 0	28 0	3 0	3 0	6 2
6	6	440 to 800	0·18 H.P.	7×8	26 0	34 0	36 8	3 18	4 0	8 2
7	7	600 to 1,100	0·24 H.P.	8×9	32 0	41 12	44 16	4 12	5 10	9 0
8	8	780 to 1,500	0·26 H.P.	10×9	36 0	46 16	50 8	5 8	6 5	10 0
9	9	1,000 to 2,000	0·38 H.P.	10×9	40 0	52 0	56 0	6 0	7 7	11 0
10	10	1,230 to 2,400	0·47 H.P.	12×9	44 0	57 4	59 8	6 12	8 10	12 0
11	12	1,770 to 3,000	0·72 H.P.	12×10	54 0	70 4	75 12	8 2	11 3	13 0
12	15	2,900 to 6,000	1·1 H.P.	14×9	75 0	...	103 0	11 5	14 3	15 6

These Pumps throw to a maximum height of 80 feet.

* The best results are obtained when the Pump is throwing the minimum quantity, and the ower given is for discharging the minimum.

Packing cases average 5 per cent on the list prices.



No.	Galls. per minute discharged approx.	H. P. to work pump 1ft. high.	Diam. of pipes.	No. of pipes.	Revolutions per min. for 10ft. lift.	Ditto for 20ft. lift.	Ditto for 30ft. lift.	Price complete for 10ft. high £ s. d.	For each extra 9ft. length of framing, shafting, &c. £ s. d.
1	500	.225	3¼in.	2	333	494	600	35 0 0	6 0 0
2	1,000	.450	4½ ,,	2	250	370	450	45 0 0	7 10 0
3	1,500	.675	5½ ,,	2	214	318	390	55 0 0	8 5 0
4	2,000	.900	6¼ ,,	2	200	295	363	70 0 0	8 15 0
5	3,000	1.35	8¼ ,,	2	163	247	300	100 0 0	9 10 0
6	5,000	2.25	10½ ,,	2	143	210	270	150 0 0	12 0 0
7	8,000	3.60	13¼ ,,	2	125	185	230	235 0 0	—
8	12,000	5.40	16 ,,	2	110	165	200	350 0 0	—

For prices of engines see pages 81—83.

WOODFORD'S PATENT

CENTRIFUGAL PUMP.

MURRAY'S PATENT CHAIN PUMPS.

CONSTRUCTED TO LIFT FROM 1,000 GALLONS TO 25,000 GALLONS PER MINUTE, 100 FEET DEEP AND UPWARDS.

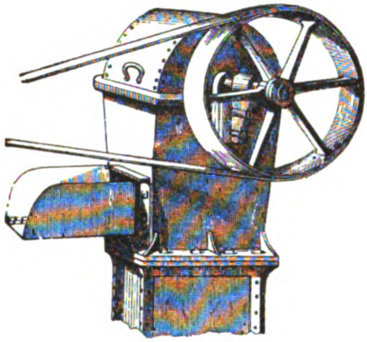
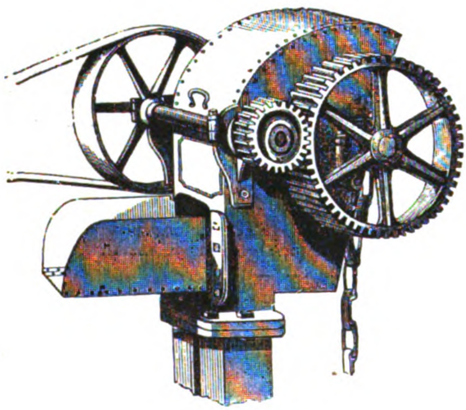


PLATE IRON SINGLE CHAIN PUMP, FOR SINKING PURPOSES.

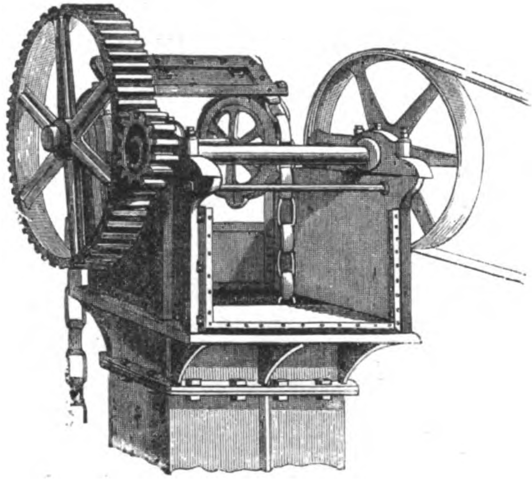
From 100 to 1,000 gallons per minute, 100 feet deep and upwards.



CAST-IRON SINGLE CHAIN PUMP.

From 1,000 to 2,000 gallons per minute, 100 feet deep and upwards.

The Barrels of these Pumps are made in 6 ft. lengths, for the convenience of sinking; so that when the Pump has sunk 6 feet, the head of the Pump is taken off, and another length of Barrel added, with an additional length of Chain, and an extra Lift, all of which can be done in a very short time, and the Pump is again ready for use.



CAST-IRON DOUBLE CHAIN PUMP, WITH GEARED HEAD.

From 2,000 to 25,000 gallons per minute. Larger if required. 100 feet deep and upwards.

THE working parts of the Chains and Lifts are Steeled, in both the large and small Pumps.

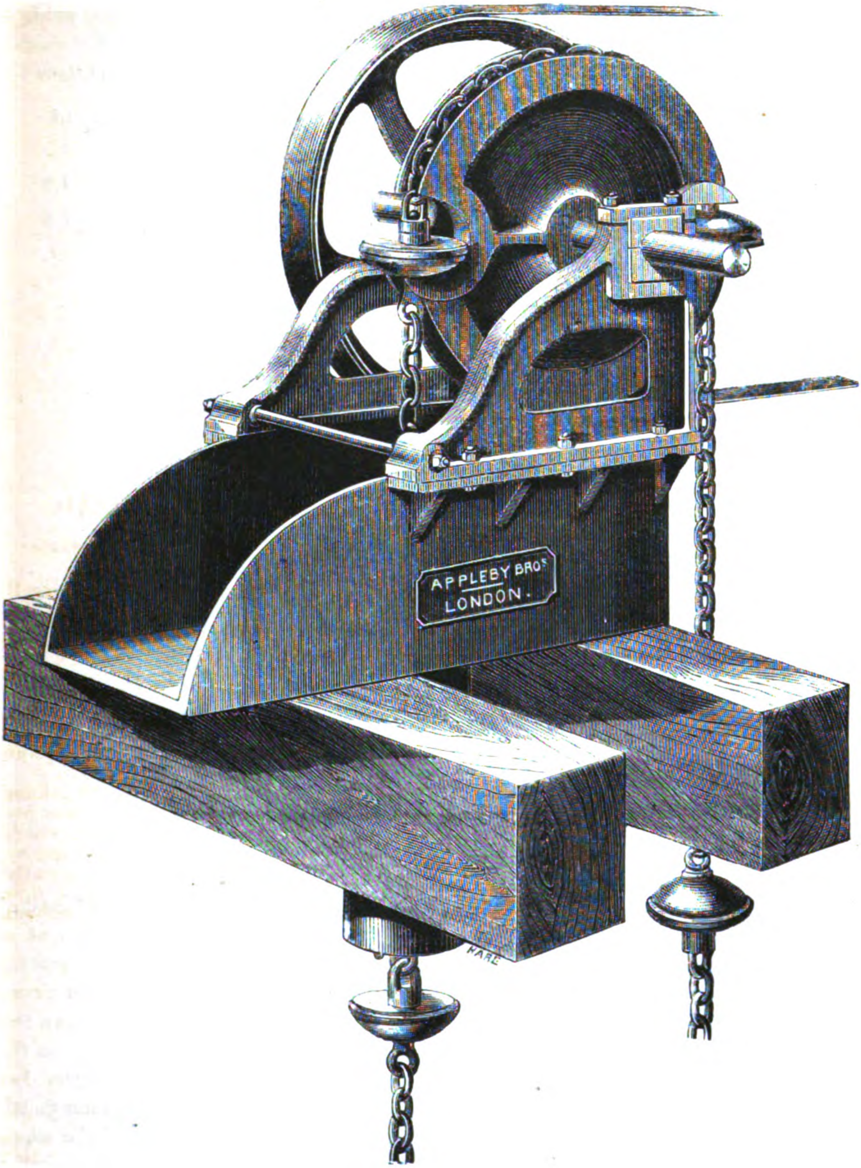
The practical results and advantages obtained by this Improved Construction of Chain Pump are far greater than those obtained by the Centrifugal, or any other class of Pump now in use. There is also a great saving in steam power and working expenses.

The total absence of Clacks, Valves, or any kind of packing, has been found so beneficial, that however foul the water may be, either from Sand, Mud, Weeds, Sewage, or any foreign matter, the Pumps do not choke, neither require stopping for a renewal of a Leather or packing to Valves or Buckets, which is such a frequent source of loss and annoyance in the common Pump.

A MURRAY'S Pump, 27 in. × 9 in. will lift 2,500 gallons per minute, or 150,000 gallons per hour, or equal to 8 Pumps of 16 in. diameter, and 2 ft. stroke, if making 20 strokes per minute; that is, supposing the 16 in. Pumps are all doing their full amount of duty, which scarcely ever happens in practice, as the smallest defect in a Valve or Bucket, or any impurity in the water, keeping the Valves off their seats, causes very considerable loss—frequently more than one-half. MURRAY'S Pump will always do duty in proportion to the speed it is driven, and which can be varied to a much greater extent than the common Pump, without running the risk of breakage or derangement.

LIST OF PRICES.

Nos.		Sizes of Pump.	Number of gallons per minute.		£	s.	d.	Nominal H. P. for 10 feet high.		£	s.	d.
Single Chains. Geared Heads extra, under 40 feet high.	1	8 × 4	500	10 feet high.	36	0	0	1½	For each additional foot in height, add	2	8	0
	2	10 × 5	709	ditto	45	0	0	2	" "	3	0	0
	3	12 × 6	1,000	ditto	54	0	0	3	" "	3	12	0
	4	14 × 7	1,300	ditto	63	0	0	4	" "	4	4	0
	5	16 × 8	1,600	ditto	72	0	0	5	" "	4	16	0
Double Chains, with Geared Heads.	6	24 × 8	2,000	ditto	96	0	0	6	" "	5	8	0
	7	27 × 9	2,500	ditto	108	0	0	7½	" "	6	0	0
	8	30 × 10	3,000	ditto	120	0	0	9	" "	6	10	0
	9	33 × 11	3,500	ditto	132	0	0	10½	" "	6	18	0
	10	36 × 12	4,000	ditto	144	0	0	12	" "	7	4	0



STRONG CHAIN PUMP FOR STEAM OR OTHER MOTIVE POWER,

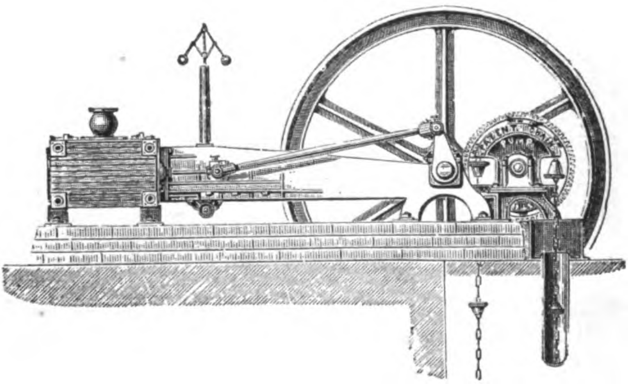
With Cast-Iron Cistern Head as shown, carrying the chain wheel and shaft with pulley, cast-iron flanged working barrel, with all necessary bolts and packings, discs and chains, and roller at bottom. For a Pump 6 inches in diameter of barrel and 30 feet deep, the price, with driving pulley, is about £42 0 0

All other sizes are made at proportionate prices, and the smaller sizes are usually made of WROUGHT-IRON for greater convenience of removal when required.

The 6-inch Pump, 30 feet deep, at 40 revolutions per minute, will raise about 215 gallons per hour.

The CHAIN PUMP to work by HAND POWER is usually mounted on a wood frame, which is made by any carpenter, the fittings and iron work being supplied, and it is found that wooden barrels or tubes work with less friction than iron, and are cheaper. The prices are as follows :—

For Wood Tube 1¾ inch diameter, at per foot	*4d.*
For set of fittings, consisting of the chain wheel for top of frame, with spindle and two bearings, frame for ratchet wheel, and roller for bottom of well	4/0
Iron Pump Spout to fit on the wooden tube, each	1/6
Iron Chain, with discs or buckets, at per foot	9*d.*



BASTIER'S PATENT CHAIN PUMP.

THESE Pumps are so simple that very little explanation is required beyond what is furnished by the illustration. It is suitable for *deep vertical lifts,* is inexpensive, and the cost of maintaining it is small. At every interval of about fifty yards a contracted part, or "working barrel," is inserted, smaller in diameter than the main pipe, and one of these is always placed at the lower end. An endless chain works over the driving wheel at the top, going down free and coming up through the tube, into which it enters by a bell-shaped mouth-piece; on the chain are placed the India-rubber discs or buckets, smaller in diameter than the main pipe, but fitting tight in the working barrels, so that all the water that enters is forced up through the rising main pipe, the discs being free all round from the pipe for nine-tenths of the whole distance, the friction is reduced to a minimum, and the power required is consequently smaller than in the ordinary Chain Pumps.

PRICE LIST.

Diam. of Pump.		Price per yard depth. £	s.	d.	Price of Pump Gear. £	s.	d.
2¼-in.	To lift from 8 to 25 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 15 yards)	1	5	0	9	0	0
	" " " " 30 "	1	6	0	12	0	0
3-in.	To lift 13 to 40 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 15 yards)	1	7	0	15	0	0
	" " " " 50 "	1	9	0	20	0	0
3½-in.	To lift from 20 to 80 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	1	12	0	18	10	0
	" " " " 60 "	1	14	0	22	0	0
4-in.	To lift from 50 to 120 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	1	18	0	22	10	0
	" " " " 50 "	2	0	0	26	0	0
	" " " " 100 "	2	2	0	30	0	0
5-in.	To lift 100 to 200 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	2	11	0	24	0	0
	" " " " 50 "	2	13	0	27	0	0
	" " " " 100 "	2	15	0	30	0	0
	" " " " 150 "	2	15	0	35	0	0
	" " " " 200 "	2	18	0	40	0	0
6-in.	To lift 150 to 300 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	3	4	0	33	0	0
	" " " " 50 "	3	6	0	36	0	0
	" " " " 100 "	3	8	0	40	0	0
	" " " " 150 "	3	10	0	45	0	0
	" " " " 200 "	3	13	0	50	0	0
7-in.	To lift 200 to 400 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	3	10	0	39	0	0
	" " " " 50 "	3	11	0	42	0	0
	" " " " 100 "	3	15	0	45	0	0
	" " " " 150 "	3	17	0	50	0	0
	" " " " 200 "	4	0	0	60	0	0
8-in.	To lift 300 to 500 Gallons per Minute :—						
	Pipes, Chains and Discs (from 3 to 10 yards)	3	17	0	40	0	0
	" " " " 50 "	4	0	0	45	0	0
	" " " " 100 "	4	2	0	50	0	0
	" " " " 150 "	4	5	0	60	0	0
	" " " " 200 "	4	7	0	70	0	0

Diam. of Pump.	Price per yard depth. £ s. d.	Price of Pump Gear. £ s. d.
9-in. To lift 350 to 600 Gallons per Minute :—		
Pipes, Chains and Discs (from 3 to 10 yards)	4 12 0	50 0 0
" " " " 50 "	4 15 0	57 0 0
" " " " 100 "	4 19 0	65 0 0
" " " " 150 "	5 4 0	72 0 0
" " " " 200 "	5 6 0	80 0 0
10-in. To lift 450 to 800 Gallons per Minute :—		
Pipes, Chains and Discs (from 3 to 10 yards)	5 11 0	60 0 0
" " " " 50 "	5 14 0	70 0 0
" " " " 100 "	5 17 0	80 0 0
" " " " 150 "	6 2 0	90 0 0
" " " " 200 "	6 4 0	100 0 0
11-in. To lift 550 to 1,000 Gallons per Minute :—		
Pipes, Chains and Discs (from 3 to 10 yards)	6 13 0	70 0 0
" " " " 50 "	6 14 0	80 0 0
" " " " 100 "	6 18 0	90 0 0
" " " " 150 "	7 1 0	100 0 0
" " " " 200 "	7 4 0	120 0 0
12-in. To lift 650 to 1,200 Gallons per Minute :—		
Pipes, Chains and Discs (from 3 to 10 yards)	7 18 0	80 0 0
" " " " 50 "	8 2 0	90 0 0
" " " " 100 "	8 4 0	100 0 0
" " " " 150 "	8 6 0	120 0 0
" " " " 200 "	8 10 0	150 0 0

For prices multiply the sum in the first column by the number of yards required, and add the sum in the second column. Example :—Price of 8-in. Pump 120 feet deep = 40 yards × £4 = £160 + 45 = £205.

Special Estimates for Sizes above 12 inches diameter.

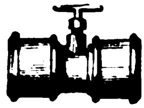
THE BASTIER PATENT PUMP.

TABLE OF POWERS REQUIRED.

Diam. of Pump.	Speed in feet per minute.	Revols. per. min.	Gallons raised per min.	Actual horse power required per foot lift.	Diam of Pump.	Speed in feet per minute.	Revols. per min.	Gallons raised per min.	Actual horse power required per foot lift.
2½ in.	50	8	9	0·0034	9 in.	150	16	350	0·132
	75	12	13	49		175	18	408	154
	100	16	18	67		200	21	466	173
	125	20	22	82		225	24	525	199
	150	24	27	0·0102		250	26	583	220
	175	28	31	115		275	29	641	242
	200	32	36	136		300	32	700	265
3 in.	50	8	13	0·0049	10 in.	150	16	432	0·164
	75	12	19	71		175	18	503	189
	100	16	26	98		200	21	576	217
	125	20	32	0·0121		225	24	648	245
	150	24	39	147		250	26	720	272
	175	28	45	170		275	29	792	300
	200	32	52	196		300	32	864	326
3½ in.	50	5	17	0·0064	11 in.	150	13	523	0·197
	75	8	26	97		175	18	610	230
	100	11	35	0·0132		200	21	697	271
	125	13	44	166		225	24	785	297
	150	16	53	200		250	26	872	330
	175	18	61	231		275	29	959	362
	200	21	70	265		300	32	1046	396
4 in.	100	11	46	0·0174	12 in.	150	16	622	0·235
	125	13	57	215		175	18	726	275
	150	16	69	261		200	21	830	314
	175	18	80	302		225	24	933	352
	200	21	92	347		250	26	1037	392
	250	26	115	390		275	29	1141	431
	300	32	138	476		300	32	1245	471
5 in.	150	16	108	0·0404	14 in.	150	16	847	0·320
	175	18	126	417		175	18	988	374
	200	21	144	545		200	21	1129	427
	225	24	162	611		225	24	1271	481
	250	26	180	675		250	26	1412	535
	275	29	198	750		275	29	1553	588
	300	32	216	792		300	32	1694	641
6 in.	150	16	155	0·0586	16 in.	150	16	1106	0·418
	175	18	181	685		175	18	1291	489
	200	21	207	785		200	21	1475	559
	225	24	233	882		225	24	1660	629
	250	26	259	980		250	26	1844	697
	275	29	285	0·1078		275	29	2028	767
	300	32	311	1177		300	32	2213	838
7 in.	150	13	212	0·0702	18 in.	150	16	1300	0·492
	175	18	247	935		175	18	1634	618
	200	21	282	0·1067		200	21	1867	706
	225	24	318	1203		225	24	2100	795
	250	26	353	1336		250	26	2334	884
	275	29	388	1470		275	29	2566	971
	300	32	423	1601		300	32	2800	1·050
8 in.	150	16	278	0·1050					
	175	18	324	1230					
	200	21	370	1400					
	225	24	417	1580					
	250	26	463	1750					
	275	29	509	1930					
	300	32	556	2100					

Multiply the number of feet in depth of lift by the horses power or part of horse power opposite the number of gallons proposed to be lifted per minute. The result will be the power required in effective or actual (not nominal) horses power.

No. 1.



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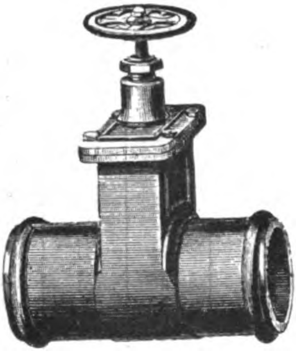

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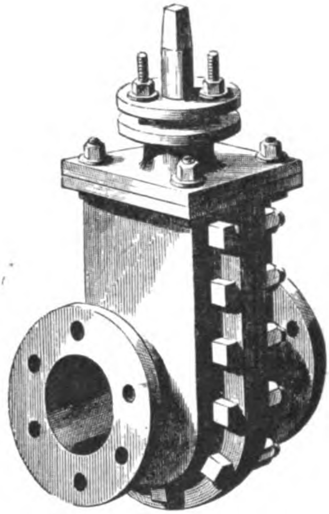

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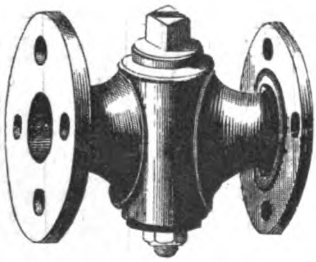

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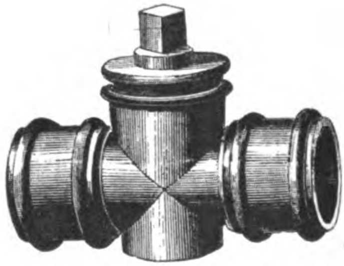


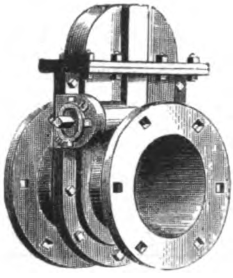
IRON SLUICE AND THROTTLE VALVES AND STOP-COCKS.

Inches Diameter . . .	1½	2	3	4
No.		£ s. d.	£ s. d.	£ s. d.
1.—Throttle Valve, with 2 sockets, brass valve, handle, and bush . . . . If with 1 socket and 1 spigot, same prices.	—	0 12 0	0 15 0	0 16 6
2.—Common Sluice Valve, for Hot Water Apparatus, with 2 sockets, brass valve, screw, and bush, iron wheel handle. If with 2 flanges, same prices.	—	1 5 0	1 10 0	1 15 0

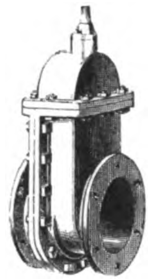
IRON SLUICE AND GAS VALVES, STOP-COCKS, &c.

NO. Inches Diameter . . .	1½	2	2½	3	4	5	6	7	8	9	10	12	15	18
3.—Best Sluice Cock double faced, with four gun-metal faces, two on the body of sluice and two on the valve, gun-metal screw and nut, either two flanges or two sockets, each . . .	45/0	50/0	61/0	67/6	88/0	113/0	135/0	163/0	188/0	213/0	238/0	300/0	520/0	665/0
3.—Ditto double faced, with two gun-metal faces, one on valve and one on sluice, gun-metal screw and nut, either two flanges or two sockets, each . .	41/6	45/0	51/6	56/6	75/0	97/0	113/0	136/0	160/0	180/0	198/0	250/0	440/0	525/0
3.—Ditto double faced, all iron faces, wrought-iron screw and gun-metal nut, two flanges or two sockets, each	—	35/0	—	47/6	65/0	82/0	98/0	114/0	130/0	150/0	163/0	200/0	350/0	425/0
3.—Gas Valve, iron faces, wrought-iron screw, cast-iron nut, two flanges or two sockets, each	—	30/0	—	37/6	50/0	63/0	75/0	88/0	100/0	113/0	125/0	150/0		
If with socket ends and bored for turned and bored joints, extra . .	—	6/3	—	7/3	8/6	12/6	15/0	19/0	21/0	25/0	28/0	34/0		
Stuffing boxes bushed with brass, 2 to 6 in. 3*s.* 9*d.*; above 6 in. 5*s.* 9*d.* extra.														
Keys for opening sluice cocks, bright, 24*s.* each; rough, 20*s.* each.														
Large deep surface box or sluice case (as shown p. 176), 12*s.* 8*d.* each.														
4.—Iron Stop-Cock with iron plug and two flanges	—	15/0	—	30/0	42/0									
Ditto, with gun-metal plug . . .	—	30/0	—	55/0	85/0									
5.—Iron Stop-Cock with extra strong brass plug and screw cap, solid bottom, wrought-iron spanner, warranted steam-tight	—	42/0	—	66/0	90/0									
Patent angle valve	—	18/6	—	25/0	30/0									
Patent horizontal valve	—	19/6	—	27/0	32/0									

DONKIN'S IMPROVED GAS AND WATER VALVES.



GAS VALVE.



WATER VALVE.

GAS VALVES.

Proved to 30lbs on the square inch.

Note.—In ordering valves it is necessary to state whether required for under or above ground, and if required with flanges, or spigots and sockets cast on, or separate spigot and socket pieces.

PROPORTIONS OF VALVES. Flange Valves, except the 20 in. and upwards, always kept in stock; Socket Valves kept in stock up to 6 in.; above that size, made to order.									Size of Separate Flange, Spigot, and Socket Pieces. All sizes up to 14 in. inclusive kept in stock.			
Bore of Valve.	Length from Face to Face of Flanges over all.	Diameter of Flanges.	Diameter of Circle through centre of Bolt Holes.	Number of Holes in Flanges.	Size of Holes in Flanges.	Length from end of Spigot to bottom of Socket.	Depth of Socket.	Price of Valves per inch diameter.	Length from Flange to end of Spigot.	Length from Flange to bottom of Socket.	Depth of Socket.	Price per inch diameter.
In.	In.	In.	In.		In.	In.	In.	s. d.	In.	In.	In.	s. d.
2	11¼	6½	0	0	0	16	2½	12 0	12	2½	2½	2 0
3	11½	8½	6½	4	¾	17	2½	10 0	12	3	2½	2 0
4	11½	10	8	4	¾	18	2½	10 0	12	3	3	2 6
5	11½	10½	9	4	¾	22	3	9 6	14	4	3	2 6
6	11½	12	10	4	¾	22	3¼	9 6	14	4	3¼	2 6
7	11½	14½	12	6	1	22	3¼	10 0	14	4	3¼	2 6
8	12½	15½	13	6	1	23	3¼	10 6	14	5	3¼	2 6
9	13½	17	14½	6	1	23	3¼	10 6	14	5	3¾	3 0
10	13½	18	15½	6	1	23	3¼	10 6	14	5	3¾	3 0
12	16	20½	17	6	1¼	28	4	11 0	18	5	4	3 0
14	16	22	19	6	1¼	28	4¼	12 0	18	5	4¼	3 0
15	17	23	19½	6	1¼	30	5	12 0	18½	5	5	3 0
16	18	24¼	21	6	1¼	30	5	12 0	19	5	5	3 0
18	18	26½	23	6	1¼	30	5½	12 0	20	5	5½	3 0
20	20	29	25	8	1¼	32	5½	14 0	20	5	5½	3 6
22	20	31	27	8	1¼	33	5½	15 0	21	5	6	4 6
24	20	33	29½	8	1¼	34	6	16 0	21	5	6	5 0
27	20	36	32½	8	1¼	36	7	18 0	23	5	7	5 0
30	22	39	35½	10	1¼	39	8	22 0	25	5	8	6 0
36	22	46	42¾	12	1¼	—	—	30 0	—	—	—	—

The above prices include an indicator for showing the extent to which the valve is open; it should only be applied when the valves are for above ground.

The spindle requires to be turned about 1¾ times to open or shut the valve, but the index plate is so connected to it, that the pointer only moves from "open" to "shut."

When the pointer is at O the valve just begins to pass gas.

Note.—When the gland is removed from the spindle for packing the stuffing box, it should be put on again with the valve quite *open* or quite *shut*, taking care that the indicator shows the same, otherwise it will not work.

The dimensions give the sizes of the valves, without allowance for joints, but they will vary slightly. The surfaces of the two joints of the valve are planed: and the pinions and spindles of wrought iron. If the proportions are required to be different from the above table, 1*s.* per inch will be charged for alterations to patterns, unless several are ordered at the same time.

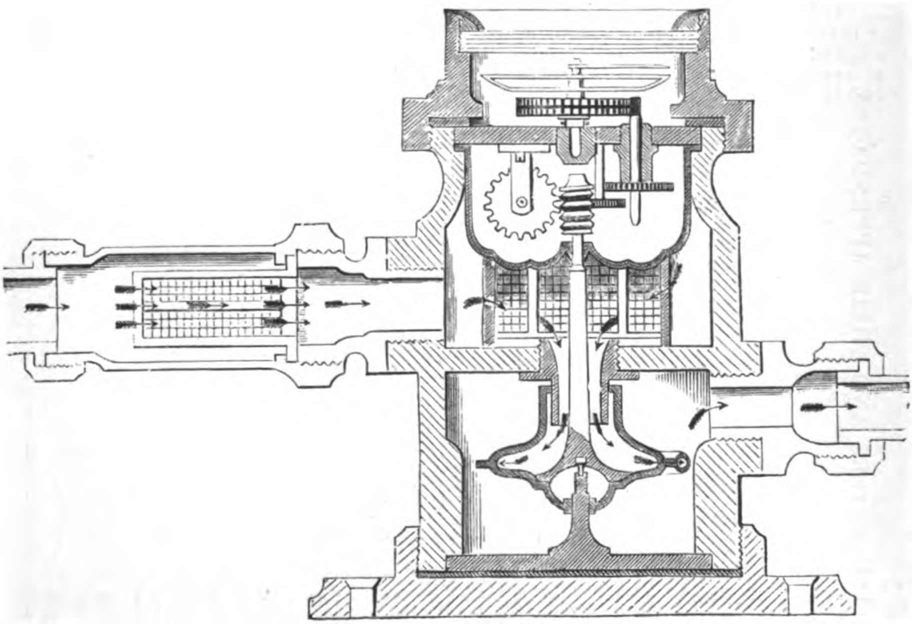
WATER VALVES

Proved to 400 feet head of water.

PROPORTIONS OF VALVES. Flange Valves.						Socket Valves.		PRICES.								
Bore of Valve.	Length from Face to Face of Flanges over all.	Diameter of Flanges.	Diameter of Circle through centre of Bolt Holes.	Number of Holes in Flanges.	Size of Holes in Flanges.	Length over ends of Sockets.	Depth of Sockets.	Per Valve, with four Gun-metal Faces, Gun-metal Screws and Nuts.			Per Valve, with four Gun-metal Faces, Wrought iron Screws, and Gun-metal Nuts.			Per Valve, with two Gun-metal Faces, Wrought iron Screws, and Gun-metal Nuts.		
In.	In.	In.	In.		In.	In.	In.	£	s.	d.	£	s.	d.	£	s.	d.
2	7½	6½	4¾	4	⅝	9	2¼	2	5	0	2	2	6	2	0	0
2½	8	7	5¼	4	⅝	10	2½	2	12	0	2	8	6	2	5	0
3	8	8½	6½	4	11/16	12	3	3	0	0	2	13	6	2	7	0
4	10	10	8	4	11/16	13	3¾	4	0	0	3	10	0	3	0	0
5	10	10½	8½	4	¾	13	4	5	0	0	4	7	6	3	15	0
6	11	12	9½	6	13/16	13	4	6	0	0	5	5	0	4	10	0
7	11	14½	12	6	13/16	14	4	7	0	0	6	7	6	5	15	0
8	12	15½	13	6	⅞	15	4¼	8	0	0	7	5	0	6	10	0
9	13	17	14	6	1	16	4½	9	9	0	8	9	6	7	10	0
10	13	18	15	6	1	17	4½	10	10	0	9	15	0	9	0	0
12	14	20	17	6	1⅛	18	5	13	10	0	12	5	0	11	0	0
14	16	22	19	6	1¼	19	5	18	10	0	17	5	0	16	0	0
15	17	23	20	6	1¼	19	5	21	0	0	19	10	0	18	0	0
16	18	26	22	6	1¼	20	5	23	0	0	21	15	0	20	10	0
18	19	27	23	6	1¼	21	5	27	10	0	25	15	0	24	0	0
20	20	29	25	8	1¼	22	5	33	0	0	31	0	0	29	0	0
21	20	30	26	8	1¼	23	5½	37	10	0	35	5	0	33	0	0
22	20	31	27	8	1¼	23	6	42	0	0	39	15	0	37	10	0
24	21	33	29½	8	1¼	24	6	49	0	0	46	5	0	43	10	0

If these valves are provided with D. & Co.'s metallic stuffing boxes, requiring no packing, the price will be increased 2*s.* per inch diameter up to 4 bore, and 1*s.* 6*d.* per inch diameter beyond that size. The Dimensions give the sizes of the valves without allowance for joints. The whole of the surfaces of the joints of the valve are planed, and the threads of the screws are made of an improved shape, to render them more durable than the ordinary square thread. If the proportions are required different from the above table, 1*s.* per inch diameter will be charged for alterations to patterns, unless several are ordered at the same time, when no extra charge will be made.

SIEMEN'S AND ADAMSON'S PATENT WATER METER.



DESCRIPTION.

This Meter is constructed upon the well-known principle of the Barkers' Mill, which has long been in use as a motive power for working Mills, and for other purposes. It is the first application of the principle to an instrument for measuring water, which is done without materially diminishing the velocity or the effective pressure. The measuring medium consists of a drum, working on an upright spindle at the bottom, and in a collar at the top. The water is conveyed by the conducting tube into the centre of the drum, and allowed to escape at three or more apertures on the periphery of the same, giving to it a rotary motion. At each revolution of the drum a certain number of cubic inches of water is delivered, so that it is not necessary to register the number of revolutions to ascertain the quantity: this is effected by wheels and pinions, and the result indicated in gallons or feet upon a graduated dial.

TERMS AND CONDITIONS UPON WHICH METERS ARE SUPPLIED.

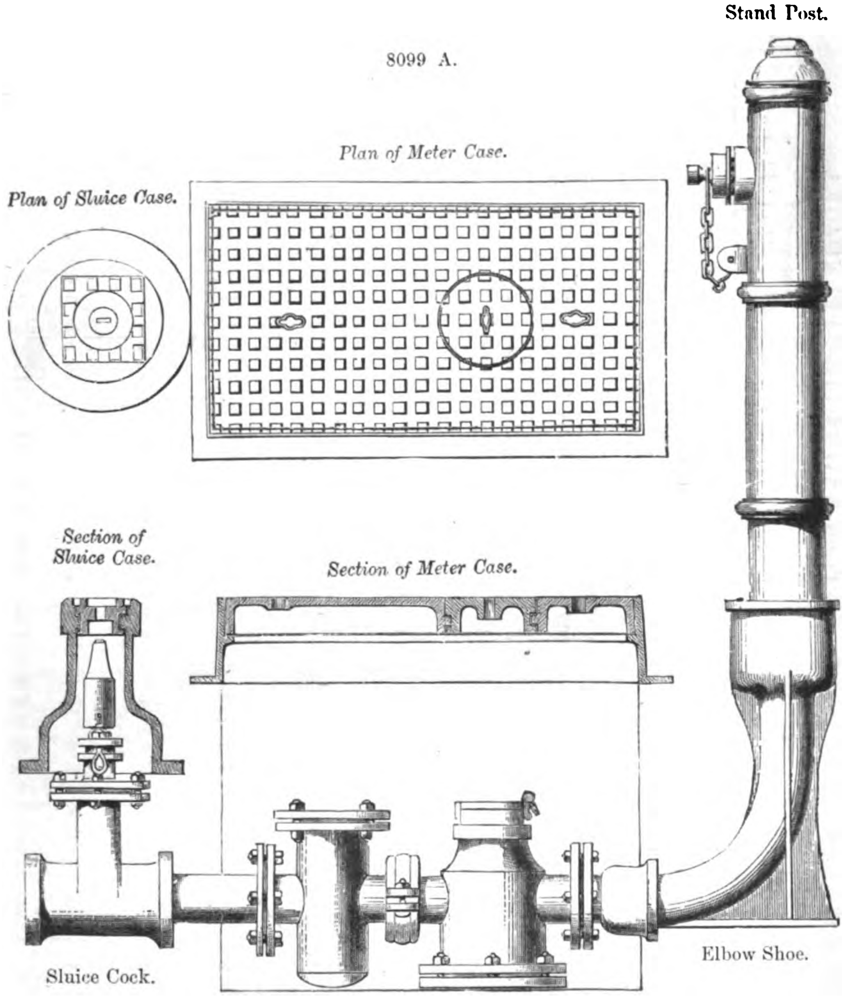
All Meters are guaranteed by the manufacturers to be delivered free from constructional defects, and in good working condition, and if preferred, they will engage to maintain the Meter permanently in working order, or replace the same at an annual charge averaging about 5 per cent. per annum on the previous cost price. Such charge to commence from the date of Invoice.

All injuries of an extraneous character arising from violence or exposure to frost to be exceptions to the above stipulations, and to be paid for according to the nature and extent of the repairs required. The carriage of Meters requiring to be repaired under the guarantee will be paid by the makers.

NUMBERS AND PRICES OF WATER METERS AND THEIR APPENDAGES.

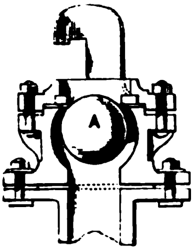
Numbers	1	2	3	4	5	6	7	7½	8	9	10	11	12	13	14
Diameters of Inlet and Outlet	3/8	1/2	3/4	1	1¼	1½	2	2½	3	4	5	6	8	10	12 in.
Gallons delivered per hour at an effective pressure of 50 ft.	150	300	600	1,500	2,200	3,000	4,000	6,000	8,300	13,400	18,500	27,000	45,000	70,000	90,000
Ditto 150 ft.	250	500	1,000	2,500	3,800	5,000	7,000	10,000	14,000	23,000	32,000	46,000	77,000	120,000	154,000
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Price of METER with Brass Filter and Unions Tinned, for Lead Pipe . . . each	2 14 0	3 8 0	4 8 0	5 3 0	6 10 0	7 14 0									
Price of METER with Flange Ends for connecting to Cast Iron Pipe . . . . each	—	—	—	5 3 0	6 10 0	7 14 0	9 6 0	11 14 0	14 0 0	18 14 0	23 8 0	28 0 0	42 0 0	56 0 0	74 13 0
DIRT BOX, with Copper Strainer for preventing foreign substances passing through Meter, Flange ends . each	—	7 6	9 6	11 0	13 0	15 0	1 10 0	1 15 0	2 0 0	2 13 0	3 8 0	4 4 0	7 10 0	10 0 0	13 0 0
DIAL OR METER COVER for preventing damage to Dial, each	2 0	2 0	2 0	3 4	3 4	3 4	4 0	4 0	4 0	4 0	4 0	6 8	6 8	6 8	6 8
Meter or Street CASES, of such dimensions as admit of the Meter being taken out without disturbing the road, each	1 6 0	1 6 0	1 6 0	1 6 0	1 6 0	1 6 0	1 18 0	1 18 0	1 18 0	1 18 0	2 16 0	2 16 0	4 0 0	—	—
Annual Charge of Guarantee.	4 0	5 4	6 8	8 0	10 8	12 0	16 0	1 0 0	1 4 0	1 10 8	2 0 0	2 7 0	3 7 0	4 10 0	6 0 0
Spigot and Sockets bolted to end of Meter & Dirt Box, each	—	—	—	7 6	7 6	7 6	8 0	10 0	11 6	15 0	1 0 0	1 4 0	1 16 0	2 10 0	6 5 0

STREET WATERING APPARATUS.

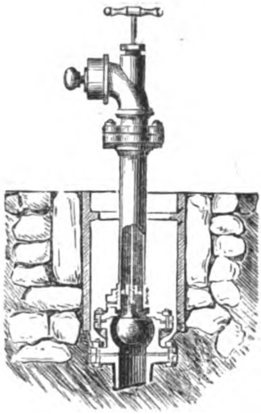


	Inches 2	2½	3	
	£ s. d.	£ s. d.	£ s. d.	
Water Meter	9 6 0	11 14 0	14 0 0	each.
Dirt Box	1 10 0	1 15 0	2 0 0	,,
Dial Cover	4 0	4 0	4 0	,,
Sluice Cock, with Socket Ends	2 13 5	3 5 6	2 12 0	,,
Meter Case	1 18 0	1 18 0	1 18 0	,,
Sluice Case	12 8	12 8	12 8	,,
Stand Post with Elbow Shoe complete for filling Water Carts	2 19 0	2 19 0	2 19 0	,,
Spigot and Socket, bolted to each end of Meter	8 0	10 0	11 6	,,

Patent High Pressure Strong Loose Valve Stop Cocks, with Cast Iron Bodies, Gun Metal Working Parts, Valve, and Seat, may be had instead of the Sluice Cock in the above arrangement, if preferred. It is desirable to place the Valve and Meters on the foot-path, or in such a position that they are not likely to get the street dirt in the boxes.



No. 1.



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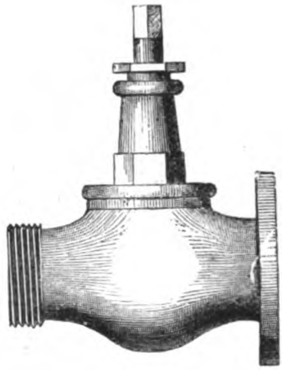


No. 3.

HYDRANTS, FIRE COCKS, &c.

No. 1. Patent HYDRANT or FIRE MAIN COCK, each 10/0

Ditto ditto with socket elbow, suitable for 2, 2½, or 3 in. pipes, each 17/6

No. 2. STAND PIPE with single revolving discharge outlet screwed to any size thread, and to suit the Hydrant, No. 1, each . . . . £3 12*s.* 6*d.*

STAND PIPE with double revolving discharge outlets and ditto ditto 4 10 0

SURFACE or STREET BOX, with loose cover, each 11*s.*

ditto with chained cover, each 12*s.*

No. 3. 2½ in. Patent High Pressure, loose valve, globe barrel FIRE COCK, all of Gun Metal, each . . . . Rough 68/0 Finished 77/0

2½ in. ditto ditto all of Brass	,,	59/0	,, 64/0
2½ ,, ,, with Cast Iron body and Brass working parts	,,	37/6	...
2½ ,, ,, ditto ditto and Gun metal hose screw	,,	48/0	...
Gun metal Caps for ditto			,, 11/6

Gun Metal Gland Fire Cocks (full way) with flanged or screwed Connections for Fire Mains.

Diameter.	1¼	1½	2	in.
Screwed for wrought-iron pipe	1/5/0	1/12/6	2/12/6	each.
Flanged for cast-iron pipe	1/7/0	1/15/0	2/17/6	,,
Caps and chains extra	3/6	5/0	6/0	,,

Hose Wrenches, 3/6 each.

FIRE BUCKETS.

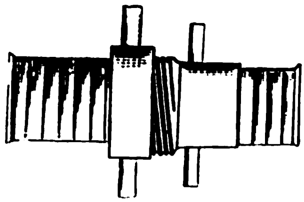
BEST LEATHER FIRE BUCKET, large size, holding about 3 gallons, with best sewn top and covered iron rim . . . . 13/6 each.

Ordnance Pattern, ditto ditto with Copper Rim, smaller 12/0 ,,

CANVAS FIRE BUCKETS . . . . 4/6 ,,

GALVANIZED IRON DITTO . . . . 4/6 ,,

No. 6.



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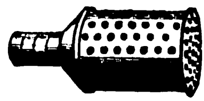


No 5.

(No. 4.) GUN METAL SWIVEL HOSE UNIONS.

	Diameter ...	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	3 in.	
(No. 4.)	Strong Unions for Leather Hose ...	3/9	5/9	6/6	10/0	11/6	15/6	21/6	each.
	Light Unions for Canvas Hose ...	3/0	4/0	5/3	7/6	...	12/6	17/6	,,
	Strong Caps for Hose Unions, with lugs	2/3	2/6	3/6	5/0	...	6/3	9/0	,,
(No. 5.)	Copper Suction Roses for Hose ...	..	...	4/9	6/3	...	8/0	9/9	,,

Galvanized iron ditto, 2/6, 3/6, and 5/0 each.

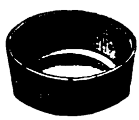
Binding Hose on Unions with copper wire, 3/6 each.

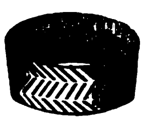
The $2\frac{1}{2}$-inch Unions are made to the London Brigade Gauge.

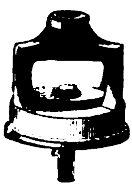
(No. 6.) Copper Hand or Branch Pipes with unions and nozzles.

	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	in.
Strong, for Fire Engines, &c.	...	...	...	15/0	21/0	30/0	36/0	each.
Light, for Garden Hose, with jet and spreader,	7/6	8/6	10/0	...	...	...	...	,,
Ditto if with stop cock,	9/6	11/6	14/6	..	...	...	...	,,

Spreaders to attach to Copper Branch pipes, 7/6







CUP LEATHERS FOR PUMPS.

Diameter.	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	5	6 in.	
For Buckets	0/8	0/9	1/2	1/6	1/8	2/2	3/0	each.
Solid Bottom for Plungers	0/9	0/10	1/6	1/7	1/10	2/6	3/3	,,
Quilted Cups for Hot Liquor Pumps . .	0/10	1/3	1/6	1/6	1/9	2/3	3/0	,,

Quilting for Hot Liquor Pumps . per yard.	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{2}$	3 in.	
	1/2	1/4	1/5	1/7	2/0	2/4	each.

STRONG BRASS PUMP BUCKETS WITH METAL VALVES.

Diameter . .	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	6 inches.
Price . . .	4/6	5/6	6/6	9/0	12/6	14/6	21/6	32/6	each.

WROUGHT COPPER PUMP SCREWS.

$\frac{3}{8}$	$\frac{1}{2}$ in.
9/6	12/6 per dozen.

CAST COPPER Ditto 7/3 per dozen.

PUMP FITTINGS.

	2½	3	3½	4	5	6 inch.
Wood Pump Buckets for Jack Pumps, clacked and leathered complete	1/9	2/0	2/3	3/0	4/0	5/0 each.
Wood Clacks, or lower Boxes, leathered complete	0/9	0/10	1/0	1/6	2/3	2/9 ,,
Brass Buckets, clacked and leathered complete	5/9	7/6	9/0	11/6	22/6	33/6 ,,
Brass Spindle Valve Buckets for hot liquids with quilted cup	7/6	9/6	12/0	16/0	26/0	— ,,
Brass Bucket, with India-rubber disc Valve, and grid and cup leather complete	4/0	5/6	7/0	9/0	16/0	22/6 ,,
Brass Clacks, or lower Boxes, with bails and fitted complete	4/0	4/4	5/6	7/6	11/6	22/6 ,,

	2	2½	3	3½	4 inch.
Copper Bucket Rod with nut, for Pump	3/6	4/0	4/6	5/6	6/0 each.

Cup Leathers, various, (see page 178.)

	For pipes 1½ or 2	2½	3 in. bore.
Cast-iron Air Vessels for flanged cast-iron pipes, with dip pipes	25/0	30/0	38/6 each.

	For pipes 1¼ or 1½	1¾ or 2	2¼ or 2½ in. bore.
Copper Air Vessels, with tinned ends for lead pipes	22/0	26/0	30/0 each.

Brass Retaining Valves	For pipes 1½	2	2½
Tinned for lead pipe	9/0	18/0	22/6 each.
Screwed for iron pipe	10/6	20/0	25/0 ,,

	1½ & 2	2½	3	4 in.
Cast-iron Retaining Valve with door, for flange pipes	25/0	30/0	35/0	42/0 each.

	For ⅝	¾	⅞	1 in. rods.
Wrought-iron Pump Rod Joints, with brass sockets or couplings	3/0	4/0	5/0	7/0 each.

	⅝	¾	⅞	1 in.
Wrought-iron Pump Rods in 12 feet lengths, including Socket Joints	0/8	0/9	1/0	1/2 per foot.

Roller Guides for ditto 3/6 to 4/0 each.
Brass bearings for Pump Rods to attach to timber stages, 4*s.* each.
Wrought-iron Clips for securing main pipe to the Well stages, 1/6 to 2/6 each.

SUNDRY FITTINGS.

4 ft. Cast-iron Girder to fix Pump on, with 4 bolts and nuts :—
For Single Pump, £1 5*s.* For Double Pump, £2. For Treble Pump, £2.

Cast-iron Well Stages, 4 feet long, with Clips to support Rising main pipe, 1½ to 2½ in. with bolts and nuts and roller guides for Pump rods ;—usually placed about 10 to 12 feet apart.
For single Pump, £1. For Double Pump, £1. 5*s.* For Treble Pump, £1 10*s.*

Wrought-iron ladder for fixing in well, at 2*s.* 3*d.* per foot.

SUNDRY FITTINGS FOR WORKING PUMPS OR MACHINERY.

	1½	1¾	2	2¼	2½	2¾ inch.
Connecting Rod Ends with wrought-iron tees and gun-metal bearings, turned, bored, and fitted with bolts, ready for welding	13/0	20/0	25/0	30/0	36/0	42/0 each.
Wrought-iron Connecting Rod Strap Heads, with brasses bored, wrought-iron gibs, and cotters and ends ready for welding	20/0	24/0	28/0	40/0	47/6	55/0 ,,

	6	9	12 in. stroke.
Cast-iron Eccentrics for working Pumps, with gun-metal bands, bored and fitted, with iron rod ready for welding	£6	£7 10*s.*	£9 each.

Cast-iron Disc or Crank Plates with turned pins, for driving pumps or machinery, at end of a shaft made any size to order. These may be made wide enough on the face to serve also as a pulley.

FIRE ENGINE AND PUMP HOSE PIPES.

SUCTION HOSE.	1¼ in.	1½ in.	1¾ in.	2 in.	2¼ in.	2½ in.	3 in.	inside.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Best Leather, copper riveted, and wired inside, per foot	...	3 9	4 3	4 6	5 1	5 4	5 9	per foot.
Best Vulcanized India Rubber and Canvas, wired inside	...	2 8	3 0	3 4	3 9	4 2	5 0	,,
Second quality, ditto, ditto	2 0	2 2	2 6	2 10	3 2	3 6	4 2	,,
Embedded spiral wire suction Hose, suitable for Acids, Steam, or Hot-water, is about one-third more for each quality . . .								

DELIVERY HOSE.	½ in.	⅝ in.	¾ in.	1 in.	1¼ in.	1½ in.	1¾ in	2 in.	2¼ in.	2½ in.	3 in.	inside.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Best Leather, sewn or copper riveted.	...	.	...	1 8	1 10	2 0	2 3	2 6	2 9	3 0	3 6	per foot.
Best Vulcanized India Rubber equal to 75 lb. pressure per square inch .	0 10	0 11	1 0	1 4	1 6	1 8	1 11	2 2	2 5	2 8	3 2	,,
Second quality	0 8	0 9	10	1 0	1 2	1 4	1 6	1 8	1 10	2 0	2 6	,,
Third ,, (light)	0 5	0 6	0 7	0 9	0 10	0 11	1 0	1 2	1 4	1 6	1 10	,,
Extra strong for steam or heavy pressure at higher prices												
Best super woven Canvas, lined . .	...	...	...	...	0 8	0 9	0 10	0 11	1 0	1 1	1 4	,,
Second quality ,, unlined .	..	...	...	...	0 7	0 7½	0 8	0 9	0 10	0 11	1 2	,,

NOTE.—All Hose pipes are subject to fluctuations in price, according to the market value of the material.
Leather Hose should be kept well greased or oiled, clean, and in a dry place.
Vulcanized India Rubber Hose requires no oiling, is strong, useful, and flexible.
Canvas Hose is cheaper than either of the foregoing and packs closer, but requires care, and should always be dried after use.
The Leather or India Rubber are recommended where much work is required.
The London Fire Brigade use chiefly Leather Hose.

GAS AND WATER PIPES AND CONNECTIONS.*

UNDERGROUND SOCKET PIPES—

Inside diameter	1½	2	2½	3	3½	4	5	6	7	8	9	10	12	14	15	16	18	20	24	inches.
In 6 ft. lengths	1/4	1/5½	1/11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	per yd.
In 9 ft. lengths	...	...	...	2/2½	3/1	3/3	4/5	5/7	7/6	8/6	11/0	11/9	13/6	17/6	18/0	20/0	24/6	28/6	36/0	„

Ditto, 3 to 6 in. bore, if 6 ft. long, at 7*d.* per yard extra. Irregular lengths charged extra.

Inside diameter	1½	2	2½	3	3½	4	5	6	7	8	9	10	12	inches.
Socket Elbows	2/3	3/7	4/3	4/6	5/5	6/10	12/3	17/0	19/0	27/0	32/6	35/0	41/0	each.
„ Tees	4/9	5/5	8/9	9/1	10/5	11/9	14/0	17/6	23/6	28/0	35/6	48/6	63/0	„
Other connections	16/0	14/0	14/0	12/6	12/6	12/6	11/6	11/6	10/9	10/9	10/9	10/9	10/9	per cwt.

FLANGE PIPES—

In 6 ft. lengths	1/11	2/6	3/3	...	...	...	...	...	...	...	...	...	...	per yard.
In 9 ft. lengths	...	...	...	3/5	4/7	5/0	6/8	8/6	11/9	14/9	17/0	18/6	26/0	„

Short or irregular lengths charged extra.

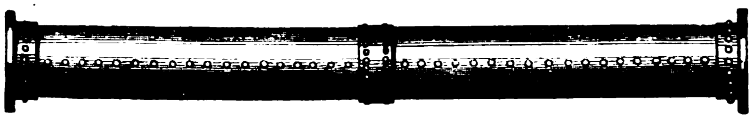
Flanged Elbows or Bends	2/0	3/7	4/4	4/10	5/5	6/10	8/4	11/7	19/0	23/6	25/0	29/0	35/0	each.
Flanged Tees	3/6	4/7	6/0	7/2	8/2	9/2	10/0	12/9	16/6	20/0	25/6	31/0	37/6	„
„ Sockets or Spigots,	1/4	2/2	3/0	3/3	3/10	4/9	5/6	8/0	11/0	13/0	15/0	16/6	22/0	„
Other connections	18/0	16/0	16/0	15/0	15/0	14/0	12/6	12/6	12/6	12/6	12/6	12/6	12/6	per cwt.
Elastic Washers for Joints, about	5/9	7/0	8/0	8/6	9/0	9/6	11/0	13/0	16/0	20/0	25/0	32/0	40/0	per dozen.

Bolts and Nuts for ditto, from 2/0 to 6/0 per doz. according to size.

Iron Washers for ditto, 0/6 to 2/0 per gross, according to size.

* These prices are *approximately* correct, but any variation in weights from those taken as a standard will affect the price in each case.

Special quotations may be given for *large quantities.*



WROUGHT-IRON RISING MAIN PIPES FOR PUMPS.

THESE Pipes are usually made in 10 or 12 feet lengths, and are lighter and stronger than Cast-iron Pipes.

	s.	d.
6½-in. dia. to clear 6-in. buckets, per ft.	7	0
8½-in. ,, ,, 8-in. ,, ,,	9	0
10¾-in. ,, ,, 10-in. ,, ,,	10	0
13-in. ,, ,, 12-in. ,, ,,	12	0
16-in. dia. to clear 15 in. buckets, per ft.	15	0
19-in. ,, ,, 18-in. ,, ,,	18	0
26-in. ,, ,, 24-in. ,, ,,	24	0

CAST-IRON FLANGED PIPES for PUMPS. (*See* p. 130.)

CAST-IRON FLANGED PIPES for GAS and WATER. (*See* p. 181.)

CAST-IRON WELL BORE PIPES, for Artesian Wells, with flush joints, turned and fitted with wrought-iron hoops and counter-sunk Screws, any size or length (special quotation).

STEEL SHOES for ditto, and BORING TOOLS of all kinds. (*See* p. 188.)

Steam Engines, Hoisting Engines, and various appliances for working ARTESIAN WELL BORING APPARATUS by Steam Power, are usually designed in each case to meet some special requirement. See also previous pages of these Engines.

COPPER AND LEAD PUMP PIPES.

STRONG BRAZED COPPER PIPE, tinned all over with collared joints for deep wells, very light, strong, durable, and perfectly pure.

Diameter	1½	2	2¼	2½	3	3½	4 inch.
Pipes per foot	1/9	2/6	3/0	3/6	5/0	5/6	6/6

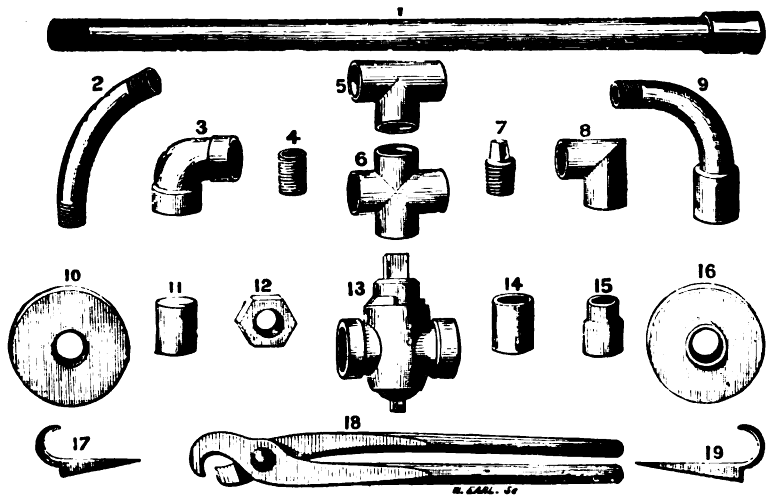
Elbows for ditto, up to 2 in., extra per foot, 9*d.*

Ditto ,, 2½ in. ,, 1*s.* 1*d.*

WEIGHT OF LEAD PIPES.

	Can be had in coils of 60 feet.		
	Common.	Medium.	Strong.
½ in. bore, weight per 15 feet length.	15 lbs.	18 lbs.	22 lbs.
⅝ ,, ,,	18 ,,	22 ,,	27 ,,
¾ ,, ,,	24 ,,	32 ,,	42 ,,
1 ,, ,,	42 ,,	56 ,,	64 ,,
	Can be had in coils of 36 feet.		
1¼ in. bore, weight per 12 feet length.	42 ,,	52 ,,	63 ,,
1½ ,, ,,	50 ,,	72 ,,	84 ,,
1¾ ,, ,,	70 ,,	81 ,,	90 ,,
2 ,, ,,	84 ,,	96 ,,	112 ,,

The price of Lead Pipe fluctuates according to the market price of lead, from about 22*s.* per cwt. upwards.

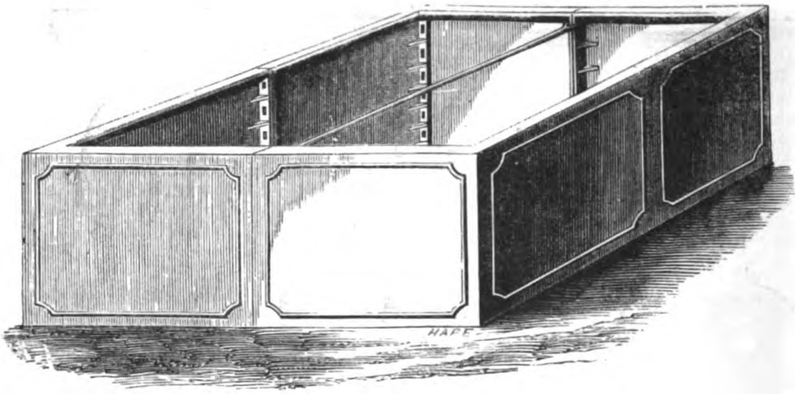


BEST WELDED WROUGHT-IRON TUBES, FOR GAS, STEAM, OR WATER.

No.	Internal Diameter . . . Inches	⅛	¼	⅜	½	¾	1	1¼	1½	1¾	2	2¼	2½	2¾	3
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1	Tubes, 2 to 14 feet long, per foot .	0 3	0 3¼	0 3¾	0 4¼	0 5	0 7	0 10	1 1	1 6	1 8	2 6	3 6	4 3	4 9
2	Springs, (9) Bends . . . . each	0 6½	0 6½	0 7	0 8	0 11	1 3	1 9	2 8	3 3	4 3	6 6	11 0	15 6	19 0
3	Elbows, Round, Malleable . ,,	0 5	0 6	0 6	0 7	0 9	1 1	1 6	2 0	3 0	3 6	4 9	8 9	11 6	14 9
8	Ditto, Wrought Iron . . . . ,,	0 6½	0 6½	0 7	0 8	0 10	1 3	1 9	2 8	3 3	3 9	5 0	9 3	13 8	16 3
4	Nipples (7) Plugs (11) Caps . ,,	0 4	0 4	0 4½	0 4½	0 5	0 6	0 8	0 9	1 1	1 3	2 0	2 6	3 3	4 3
5	Tees, Equal or Diminishing . ,,	0 6½	0 6½	0 7	0 9	1 1	1 6	2 0	2 6	3 6	4 0	5 6	10 6	14 6	18 0
6	Crosses . . . . ,,	1 0	1 0	1 1	1 5	1 9	2 3	3 0	3 6	4 3	4 9	9 6	17 3	23 0	29 0
10	Flanges, Wrought . . . . . ,,	0 10	0 10	0 10	1 0	1 2	1 4	1 6	1 9	1 11	2 6	3 9	5 0	6 9	8 6
16	Ditto, Malleable, with Collars outside diameter . . . . ,,		1 2 in. 2¾	1 2 in. 3	1 5 in. 3¼	1 7 in. 4	1 9 in. 4⅜	2 0 in. 4¾	2 5 in. 5¼		3 0 in. 5¾				
			s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.		s. d.				
12	Back Nuts (15) reducing Socket ,,	0 4	0 4	0 4½	0 4½	0 5	0 6	0 8	0 9	1 1	1 3	2 0	2 6	3 3	4 3
13	Main Cocks . . . . ,,	2 6	2 6	2 6	3 0	3 9	5 0	8 6	11 0	15 0	18 0	30 0	39 0	51 0	59 0
14	Plain Sockets . . . . ,,	0 2½	0 2½	0 3	0 3	0 4	0 5	0 7	0 8	0 10	1 0	1 6	2 9	4 0	5 0
17, 19	Pipe Hooks . . . . ,,														
18	Pipe Tongs (See pages 44–5) . .														
	Short Pieces under 2 feet . . .	0 5	0 6	0 7	0 8	0 9	1 1	1 6	2 0	2 8	3 0	4 6	6 3	8 0	9 0
	Connecting Pieces or Long Screws	0 7	0 8	0 9	0 11	1 2	1 6	2 0	2 3	3 0	4 0	5 3	7 3	9 0	10 6

Discount. Gas Tubes. Galvanized. For Steam.

Brazed Copper Steam Tubes 1 to 3 inches diameter at 1/4½ per lb.
Ditto ditto Gas Tubes ⅜ to 3 inches diameter 1/5 per lb.
Ditto Brass Steam Tubes 1/1½ per lb.
Ditto ditto Gas Tubes ⅜ to 3 inches diameter, 1/2 per lb.
Solid or Seamless Copper Tubes.
Ditto Brass Locomotive and Marine Boiler Tubes.
N. B.—These prices fluctuate with the metal market.



CAST-IRON TANKS OF EVERY DESCRIPTION.

Cast-iron Tank Plates, all sizes, at 7/6 per cwt.

Ditto ditto, with planed edges, at 9/0 per cwt.

Wrought-iron Tanks and Cisterns. These may be delivered *in plates*, or fitted and fixed complete, to order.

Wrought-iron Tank Bolts with square necks and square nuts :—

$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$ in. × 2 to 3 in. long.
13/0	14/0	21/0	21/0 per gross.

Wrought-iron Washers for ditto, 1/6 to 2/6 per gross.

WROUGHT-IRON WATER TANKS AND CISTERNS.

STRONG ROUND WROUGHT-IRON CISTERNS, made for export, to nest inside each other for convenience of stowage, with stays and loose covers. The dimensions may be varied to any extent desired.

CONTENTS AND DIMENSIONS.

Gallons.	Diam.		Deep.	£	s.	d.
100	3 ft. 6 in.	×	2 ft. 3 in.	4	0	0
200	3 ,, 6 ,,	×	3 ,, 6 ,,	7	0	0
300	4 ,, 0 ,,	×	4 ,, 0 ,,	8	15	0
500	4 ,, 6 ,,	×	5 ,, 3 ,,	14	10	0
750	5 ,, 0 ,,	×	6 ,, 3 ,,	18	10	0
1000	5 ,, 6 ,,	×	7 ,, 0 ,,	21	0	0
1500	6 ,, 6 ,,	×	8 ,, 0 ,,	28	5	0
2000	7 ,, 0 ,,	×	8 ,, 6 ,,	31	15	0
3000	8 ,, 6 ,,	×	8 ,, 6 ,,	42	0	0

SQUARE OR OBLONG Cisterns and covers, of the same thickness and contents average *about* 20 per cent more than the above.

Extra for Brass draw-off Cocks and Iron overflow Pipes from 33/0 to 45/0 each Cistern.

Lighter Tanks are made if desired, and at proportionate prices.

CASTINGS FOR GAS AND WATER WORKS.

Plug Cocks for Socket and Flange Pipes (see page 171). Sluice and Throttle Valves (see page 171).

Cast-Iron Gas Retorts, best quality.		£	s.	d.
D shape, any size . . .	per ton	6	10	0
Ditto, ditto, B.B. .	,,	7	10	0
Retort Mouth Pieces and Lids,	per cwt.	0	11	6
H Pipe and Caps for ditto .	,,	0	13	0
Hydraulic Mains	,,	0	12	0
Ascension Pipes	,,	0	12	6
Furnace Doors, unfitted .	,,	0	13	0
Fitting, extra . . .	each			

		£	s.	d.
Furnace Bars	per cwt.	0	12	6
Furnace Pans	,,	0	13	0
Sight Holes	,,	0	14	0
Scrubbers, Condensers, and Purifiers (cast in loam) .	,,	0	13	0
Pillars for ditto	,,	0	11	6
Columns with Caps and Wheels	,,	0	11	6
Tank Plates (see opposite).				

Street-lamp Columns, various patterns, from 25/0 each.

Wrought-iron Tank-bolts and Nuts, any size (see opposite).

Wrought-iron Gas-holders, any size, to order.

Fixed or Portable Gas Works, for Oil or Coal Gas, to supply any number of lights, for Factories, Mansions, Public Buildings, &c. by special contract (see pages 359 to 361).

BUILDERS' CASTINGS.

		Per Ton. £	s.	d.
Ashes Grates		14	0	0
Barrow Wheels, any size . . .		13	0	0
Contractors' Waggon Wheels and Pedestals (see page 212),	from	9	0	0
Columns, plain, solid . .	,,	7	0	0
Ditto, ditto, hollow . .	,,	8	0	0
Cannon, any size, of best cold blast metal	,,			
Dampers and Frames (large)	,,			
Engine Castings in general .	,,	12	0	0
Ditto, Cylinders, according to size and pattern . .	,,			
Ditto, Fly Wheels; good patterns of all sizes . .	,,			
Furnace Bars (large) . . .	,,	8	0	0
Ditto, doors & frames (large)	,,	10	0	0
Ditto, ditto (small)	,,	12	0	0
Girders, plain (see page 212)	,,	7	0	0
Hay Racks (see page 378, &c.)	,,	12	0	0
Hot Plate Metal	,,	12	0	0
Kitchen Range Metal . .	,,	12	0	0

		Per Ton. £	s.	d.
Kiln Plates	from			
Mangers (see page 378, &c.)	,,	12	0	0
Mash Tub Bottoms . . .	,,			
Pans, jacketed, for steam (cast in loam)	,,	10	10	0
Pile Shoes (special rate) . .	,,			
Railway Chairs (ditto) . .	,,			
Register Stove Metal . . .	,,	16	0	0
Shot and Shell, according to size	,,			
Sugar Mill Castings . . .	,,	10	0	0
Sash Weights	,,	6	0	0
Sewer Grates and Frames .	,,	11	0	0
Stable Posts and Sills (see pages 378, &c.) . . .	,,	12	0	0
,, Grates and Traps (see p. 379)	,,	11	10	0
Staircase Bars and Panels .	,,	16	0	0
Ships' Pump Castings (unfitted)	,,	10	0	0
Street Grates and Frames .	,,	10	0	0
Wall Plates	,,	12	0	0
Windows, various patterns (see page 381). . . .	,,			

PRICES OF JACKSON'S PATENT MACHINE-MOULDED COG-WHEEL CASTINGS.

Any size, pitch, number, form, or breadth of Cogs.

SPUR WHEELS	above 1 ton each and above 4 inches pitch . .	6*d.*	per Cwt.
,, ,,	above 1 ton each and under 4 inches pitch . .	12*s.* 0*d.*	,,
,, ,,	above 10 cwt. each and under 20 cwt.	13*s.* 0*d.*	,,
,, ,,	above 3 cwt. each and under 10 cwt.	14*s.* 0*d.*	,,

BEVEL and MORTICE WHEELS 2*s.* per cwt. extra.

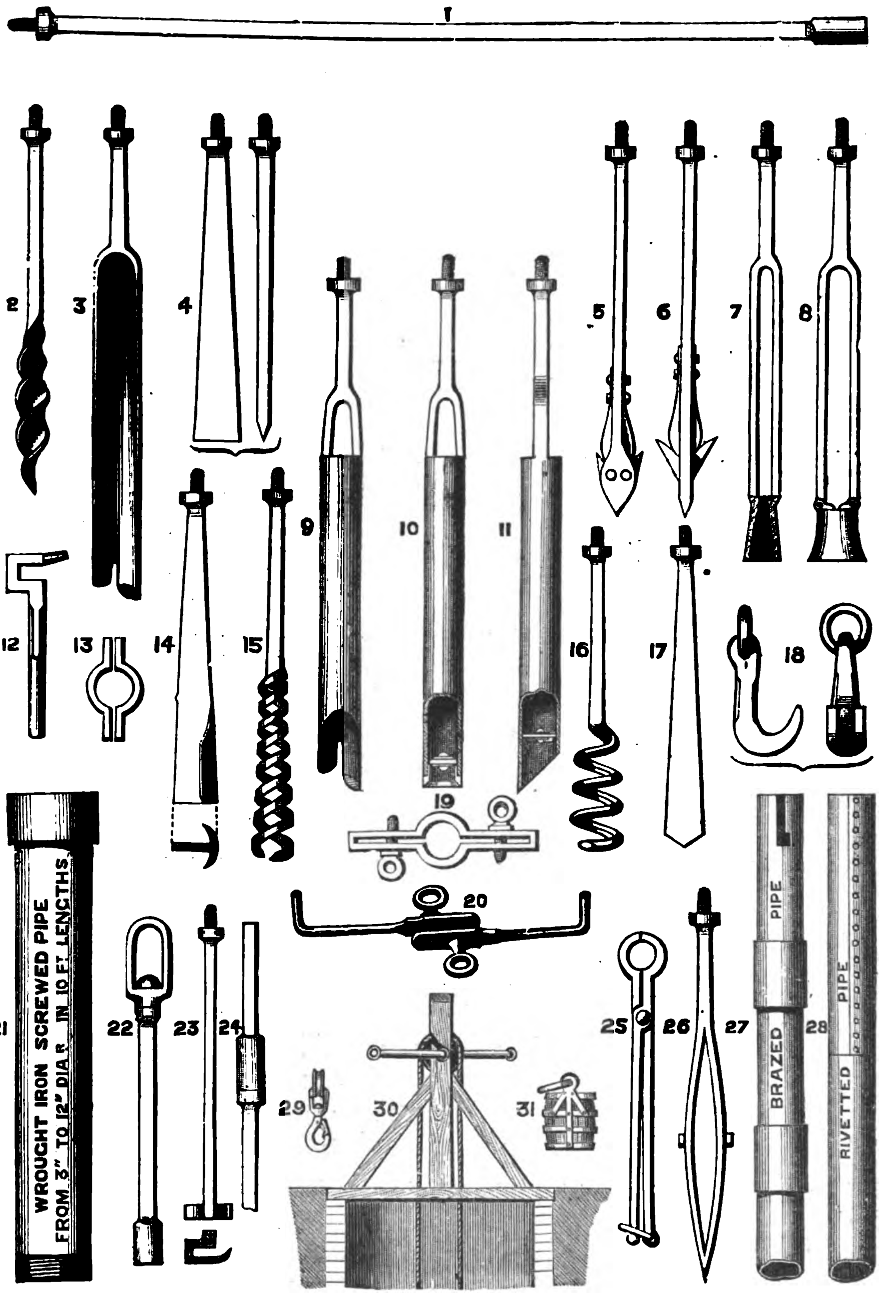
Wheels under 3 cwt. each are charged at 5*s.* per cwt. in addition to a fixed charge of 25*s.* each for Spur Wheels, and 35*s.* each for Bevel Wheels.

Wheels flanged at both ends of the cogs, and wheels cast in halves, 1*s.* per cwt. extra. Plates and Bolts at 5*d.* per lb.

When two or more Wheels are ordered to the same dimensions at the same time, one is charged as above, and the rest at the following rates :—

SPUR WHEELS	above 1 ton each and above 4 inches pitch . .	9*s.* 6*d.*	per Cwt.
,, ,,	above 1 ton each and under 4 inches pitch . .	10*s.* 0*d.*	,,
,, ,,	above 10 cwt. each and under 20 cwt.	10*s.* 6*d.*	,,
,, ,,	above 3 cwt. each and under 10 cwt.	11*s.* 0*d.*	,,
,, ,,	above 1 cwt each and under 3 cwt.	12*s.* 0*d.*	,,

BEVEL and MORTICE WHEELS 2*s.* per cwt. extra.



WELL-BORING TOOLS AND APPARATUS.

INDEX TO ILLUSTRATIONS OF WELL BORING TOOLS.

1.—Well Rod, usual length 10 feet.
2.—Worm Auger.
3.—Open Auger, for clay.
4.—Flat Chisel for stone or flint.
5.—Spring Dart, to draw faulty pipes from the borehole.
6.— Ditto ditto, for smaller pipes.
7.—Bell Screw, for withdrawing broken Rods.
8.—Bell Box, for ditto.
9.—Auger Nose Shell, with valve for loose soil or sand.
10.—Flat Nose Shell, for similar purposes.
11.—Shoe Nose Shell, for harder ground.
12.—Hand Dog, for screwing and unscrewing the Rods.
13.—Pipe Clams, or Rests.
14.—Tee Chisel, for flint or stone.
15.—Wad Hook, for withdrawing stones, &c. which may fall into the borehole.
16.—Spiral Angular Worm for withdrawing broken Rods.
17.—Diamond or Drill pointed Chisel for hard ground.
18.—Lifting Dog for raising and lowering the Rods.
19.—Long Pipe Clams, or Rests.
20.—Tillers, or Levers for turning the Rods.
21.—Wrought-iron Screwed Well Bore Pipe.
22.—Short Rod, with Swivel Head.
23.—Crow's Foot for extracting the broken Rods from borehole.
24.—Pair of Well Rod Joints ready to shut up for greater lengths.
25.—Pipe Tongs or Heaters for making joints to Pipes.
26.—Tee Piece or Pipe Dog for lowering the pipes.
27.—Brazed and Collared Pipe, with water-tight soldered joints.
28.—Common Rivetted Pipe, strong make.
29.—Spring Hook to be attached to Well Rope for raising tools, &c.
30.—Windlass complete, for Boring or Sinking.
31.—Strong Well Sinking Bucket.

In ordering Boring Tools it is necessary to state the probable *depth* of borehole, the *diameter* of borehole at the bottom, the *naturr* of the *strata* through which the tools are required to pass, and the *purpose* for which they are required—whether for Artesian Well-boring, for testing ground for minerals, or for foundations of buildings, railways, or other works. Any further information which can readily be given may frequently be useful as a guide to the selection of the most *suitable* tools.

WELL BORING TOOLS—*continued.*

No. 1.—ESTIMATE FOR A SET OF TRIAL BORING TOOLS, FOR A DEPTH OF FORTY FEET.

Eight 6 feet Boring Rods, 1 in. square; three Augers, *i.e.* 4, 3, 2½ in.; 3 Chisels, *i.e.* 4, 3, 2½ in.; one 3 in. Shoe Nose Shell, one 2½ in. flat bottom ditto, one pair of Tillers, two Lifting Dogs, two Hand Dogs, one Auger Board, one Auger Clearer.

The cost of the above set of Tools is £26 10*s.*

No. 2.—ESTIMATE FOR A SET OF BORING TOOLS, FOR A DEPTH OF ONE HUNDRED FEET.

Nine 10 feet Boring Rods, 1 in. square; one 6 feet ditto, and one 5 feet ditto, with swivel head; four Augers, *i.e.* 6, 5, 4, 3 in.; five Chisels, *i.e.* 6, 5, 4, 3, 2½ in.; three Shoe Nose Shells, *i.e.* 5, 4, 3 in.; one flat bottom Shell, 2½ in.; one pair of Tillers, two Lifting Dogs, two Hand Dogs, one Auger Board, and one Auger Clearer.

The cost of the above set of tools is £48.

No. 3.—ESTIMATE FOR A SET OF TOOLS, FOR A DEPTH OF 150 FEET.

With the same bottom tools as for No. 2 set, but with the addition of five 10 ft. lengths of rod, the price is £57 10*s.*

No. 4.—ESTIMATE FOR A SET OF TOOLS, FOR A DEPTH OF 200 FEET.

With the same bottom tools as for No. 2 set, but with 1¼ in. square rods, the price is £70.

No. 5.—ESTIMATE FOR A SET OF TOOLS, FOR A DEPTH OF 300 FEET.

With the same bottom tools as for No. 2 set, but with 1½ in. square rods, the price is £81.

A strong Iron-bound Windlass would be necessary for the men to pull up the Rods, and this would cost from £9 to £12 10*s.* according to size.

It is also necessary to have a T piece for each size of pipe to lower it down, and one pair of Tongs and two pairs of Clams for each size pipe for making the joints.

The Pipes necessary to case the Borehole average as follows, viz.—

STRONG WROUGHT-IRON BRAZED and COLLARED BORE PIPES, usually made up in 9 or 12 feet lengths.

Diameter outside . . . inches	3	4	5	6	7	8	9	10	11	12
Thickness Birmingham Wire Gauge	15	14	14	12	12	12	12	10	10	10
Price . . . . per foot	3/3	4/0	5/0	6/0	7/0	8/6	10/0	12/0	14/0	15/0
RIVETTED PIPE . . . . ditto	2/9	3/3	4/0	4/9	5/6	6/0	6/6	8/0	9/6	11/6
STEEL COLLARS & SHOES to drive, ea.	10/0	12/0	15/0	20/0	27/6	40/0	55/0	70/0	85/0	95/0

CAST IRON WELL BORE PIPES with flush joints, turned and fitted with counter-sunk screws, and wrought-iron collars, any size or length to order.

STEEL SHOES for ditto ditto.

CAST-IRON OR WROUGHT-IRON CYLINDERS made any size to order, either whole or in parts.

APPLEBY'S TABLE *showing the* NUMBER *of* GALLONS DISCHARGED PER MINUTE *by a Single-Acting Pump of a given Diameter and Stroke at* 10 *Strokes per Minute.*

LENGTH OF STROKE IN INCHES.

Diameter of Pump Barrel in inches.	1	2	3	4	5	6	7	8	9	10	12	14	15	16	18	20	24	Diameter of Pump Barrel in inches.
1	·028	·056		·112	·140	·168	·196	·224	·252	·280	·336	·392	·420	·448	·504	·560	·672	1
1¼	·044	·088	·132	·176	·220	·264	·308	·352	·396	·44	·528	·616	·660	·704	·792	·88	1·056	1¼
1½	·063	·126	·189	·252	·315	·378	·441	·504	·567	·63	·756	·882	·945	1·008	1·134	1·26	1·572	1½
1¾	·086	·172	·258	·344	·430	·516	·602	·688	·774	·86	1·032	1·204	1·29	1·376	1·548	1·72	2·064	1¾
2	·113	·226	·339	·452	·565	·678	·791	·904	1·017	1·13	1·356	1·582	1·695	1·808	2·034	2·26	2·712	2
2½	.176	·352	·528	·704	·880	1·056	1·232	1·408	1·574	1·76	2·112	2·464	2·64	2·816	3·148	3·52	4·224	2½
3	.254	·508	·762	1·016	1·270	1·524	1·778	2·032	2·286	2·54	3·048	3·55	3·81	4·06.	4·57	5·08	6·09	3
3½	·346	·692	1·038	1·384	1·730	2·07	2·42	2·76	3·11	3·46	4·15	4·84	5·19	5·52	6·22	6·92	8·30	3½
4	·452	·91	1·35	1·82	2·26	2·71	3·16	3·61	4·06	4·52	5·42	6·32	6·78	7·22	8·12	9·04	10·84	4
4½	·572	1·14	1·71	2·29	2·86	3·43	4·00	4·57	5·14	5·72	6·86	8·0	8·57	9·14	10·28	11·44	13·72	4½
5	·7	1·4	2·1	2·8	3·5	4·2	4·9	5·6	6·3	7·	8·4	9·8	10·5	11·2	12·6	14·0	16·8	5
5½	·8	1·70	2·55	3·40	4·25	5·10	5·95	6·8	7·65	8·5	10·2	11·9	12·75	13·6	15·3	17·0	20·4	5½
6	1·01	2·02	3·03	4·04	5·05	6·06	7·07	8·08	9·09	.10·1	12·12	14·14	15·15	16·16	18·18	20·20	24·24	6
7	1·38	2·77	4·15	5·54	6·92	8·31	9·69	11·08	12·06	13·85	16·62	19·38	20·77	22·16	24·12	27·7	33·24	7
8	1·80	3·61	5·42	7·23	9·04	10·85	12·66	14·47	16·28	18·09	21·7	25·32	27·13	28·94	32·56	36·18	42·14	8
9	2·289	4·57	6·86	9·15	11·44	13·73	16·02	18·31	20·60	22 89	27·46	32·04	34·33	36·62	41·2	45·78	54·92	9
10	2·827	5·45	8·48	11·30	14·13	16·96	19·78	22·61	25·44	28·27	33·92	39·56	42·40	45·22	50·88	56·54	67·84	10
12	4·068	8·13	12·20	16·27	20·34	24·40	28·47	32·54	36·61	40·68	48·8	56·94	61·02	65·08	73·22	81·36	97·6	12
15	6·361	12·72	19·08	25·44	31·80	38·16	44·52	50·88	57 24	63·61	76·32	89·04	95·41	101·76	114·48	127·22	152·64	15
18	9·158	18·31	27·47	36·63	45·79	54·94	64·10	73·26	82·42	91·58	109·88	128·2	137·37	146·52	164·84	183 16	219·76	18
20	11·307	22·61	33·921	45·23	56·53	67·84	79·15	90·45	101·76	113·07	135·68	158·3	169·6	180.9	203·5	226·14	271·36	20
24	16·282	32·56	48·84	65·12	81·41	99·69	113·97	130·25	146·53	162·82	195·4	227·9	244·23	260·5	293·0	325·6	390·8	24
	1	2	3	4	5	6	7	8	9	10	12	14	15	16	18	20	24	inches.

The Quantities given in the Table are in gallons, and are calculated for Single-Acting Pumps at 10 Strokes per minute; if required for Double-Acting Pumps, the number found in the Table should be doubled. The quantity for any other number of strokes may be found by multiplying or dividing the number found in the Table.

*** For convenience of reference this Table is given here, as well as at page 425.

TABLE

SHOWING THE QUANTITY OF WATER PER LINEAR FOOT IN PUMPS OR VERTI PIPES OF DIFFERENT DIAMETERS.

Diameter of Pump in inches.	Number of gallons per linear foot.	Number of cubic feet per linear foot.	Diameter of Pump in inches.	Number of gallons per linear foot.	Number of cubic feet per linear foot.
2	·136	·0218	8	2·176	·3490
2¼	·172	·0276	8¼	2·314	·3712
2½	·212	·0340	8½	2·456	·3940
2¾	·257	·0412	8¾	2·603	·4175
3	·306	·0490	9	2·754	·4417
3¼	·359	·0576	9¼	2.909	·4666
3½	·416	·0688	9½	3·068	·4923
3¾	·478	·0766	9¾	3·232	·5184
4	·544	·0872	10	3·400	·5454
4¼	·614	·0985	10¼	3·572	·5730
4½	·688	·1104	10½	3·748	·6013
4¾	·767	·1230	10¾	3·929	·6302
5	·850	·1363	11	4·114	·6599
5¼	·937	·1503	11¼	4·303	·6902
5½	1·028	·1649	11½	4·496	·7212
5¾	1·124	·1803	11¾	4·694	·7529
6	1·224	·1963	12	4·896	·7853
6¼	1·328	·2130	12½	5·312	·8521
6½	1·436	·2304	13	5·746	·9217
6¾	1·549	·2489	13½	6·196	·9939
7	1·666	·2672	14	6·664	1·0689
7¼	1·787	·2866	15	7·650	1·2271
7½	1·912	·3067	16	8·704	1·3962
7¾	2·042	·3275	18	11·016	1·7670

TABLE

SHOWING THE POWER IN FOOT POUNDS REQUIRED TO RAISE A GIVEN QUANTITY OF WATER A GIVEN HEIGHT.

Height in Feet.	NUMBER OF GALLONS RAISED PER MINUTE.											Height in Feet.
	1	2	3	4	5	10	20	30	40	50	100	
1	20	40	60	80	100	175	300	425	550	675	1200	1
2	30	60	90	120	150	275	500	750	950	1175	2200	2
3	40	80	120	160	200	375	700	1025	1350	1675	3200	3
4	50	100	150	200	250	475	900	1325	1750	2175	4200	4
5	60	120	180	240	300	575	1100	1625	2150	2675	5200	5
10	110	220	330	440	550	1076	2102	3128	4154	5180	10210	10
20	210	420	630	840	1050	2076	4102	6128	8154	10180	20210	20
30	310	620	930	1240	1550	3076	6102	9128	12154	15180	30210	30
40	410	820	1230	1640	2050	4076	8102	12128	16154	20180	40210	40
50	510	1020	1530	2040	2550	5076	10102	15128	20154	25180	50210	50
100	1010	2020	3030	4040	5050	10076	20102	30128	40154	50180	100210	100

The Numbers given in the Table are in foot lbs. including allowance for friction.

A foot pound = 1 lb. raised 1 foot high in 1 minute.

A man is capable of exerting 6000 ft. lbs. for 10 hours a day. 33000 ft. lbs. = 1 H. P.

⁎ For convenience of reference these Tables are given here, as well as at page 426.

CONTRACTORS' MACHINERY AND TOOLS,

RAILWAY PLANT

AND

MATERIALS.

MORTAR AND LOAM MILL.

THE conditions required are that the Mill should thoroughly mix the materials, and (in many cases) that there should be sufficient weight in the rollers to crush and pulverise hard burnt ballast, or even large pieces of brick and other substances of equal bulk and hardness.

The Mill almost universally adopted is that illustrated and described as No. 1, which has a revolving pan with rollers turned round on a fixed axis by the revolution of the pan, but the Authors believe that, whether for mixing or grinding, or for both combined, the No. 2. Mill, in which the pan is fixed and the central axis (on which the rollers turn) is made to revolve, and thus give a turning motion to the roller, is preferable; and this conclusion has been formed after a careful observation of each system.

In the revolving pan, a centrifugal action is set up, and the materials collect behind the scrapers, so that only a small stream is submitted to the action of the rollers throughout each revolution of the pan, and the mortar must be shovelled or scooped out by manual labour.

But in the No. 2. Mill, with fixed pan, the scrapers revolve with the rollers, and continually change the position of the materials to be operated upon, without the inconvenience of the centrifugal action incidental to the revolving pan. When the Mortar is mixed ready for use, the sliding door in the side of the pan is lifted and a scraper is lowered on the bottom of the pan, and in a few revolutions the contents are discharged without manual labour.

In addition to the above-named advantages the No. 2 Mill is driven with less power than the No. 1, or in other words the engine power being equal, a No. 2 Mill will turn out more work than a No. 1.

The subjoined information is derived from observation, and being confirmed by several of the engineers in charge of large works, such as the Metropolitan Railways, the Thames Embankment works, &c. it may be relied upon as being correct.

Diameter of Pan	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
Approximate Horse power required for No. 1 Mill	4	5	6	7	8	10
Product per hour, cubic yards	6	10	14	18	22	25
Horse power required for No. 2 Mill	3½	4	5	6	7	8
Product per hour *	6	10	14	18	22	25

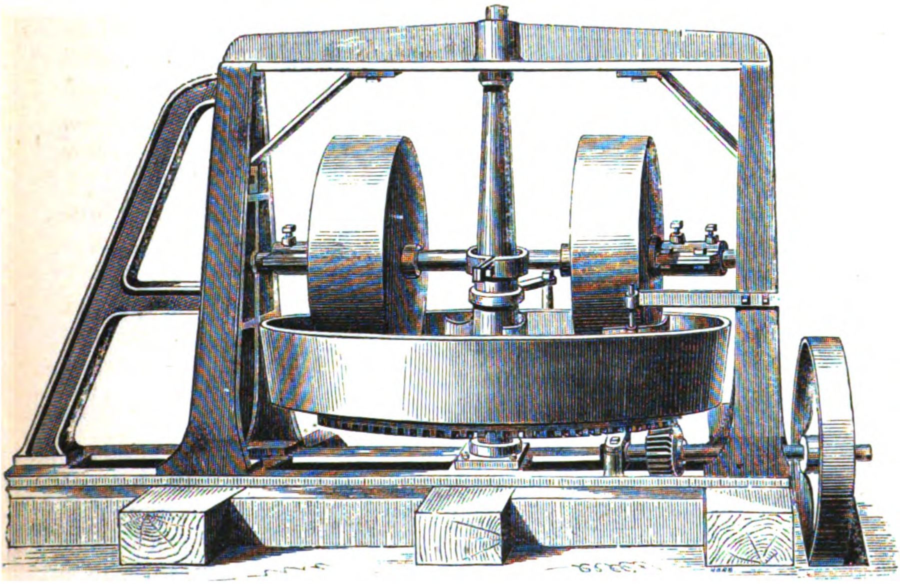
* These data assume that a large proportion of burnt ballast and brick-end are ground down with a comparatively small mixture of sharp sand; where

sharp sand only is used the yield will be proportionately increased, as the Mill will then only be required to grind the nodules of lime, and to thoroughly amalgamate the lime and sand, and under these conditions the yield will be about double that stated.

The No. 3 Mill is in principle the same as No. 2, but in order to render it available for use on works where the large Steam Mills would be unsuitable, it is fitted with one or two poles or levers with cross-trees to work by horse or bullock power, and with broad travelling wheels (the front pair with locking-plate) and shafts for facility of moving from place to place.

In many situations, such as excavations for gas tanks, foundations for large buildings, &c. a portable steam crane (see page 14) has been used for lifting the materials excavated, and at the same time employed for driving the pan when mortar was required.

When required for steam power, a bevel wheel is keyed on the central axis below the pan with a short shaft carrying a bevel pinion and strap pulley in addition to the poles above-named.



No. 1 MORTAR OR LOAM MILL.

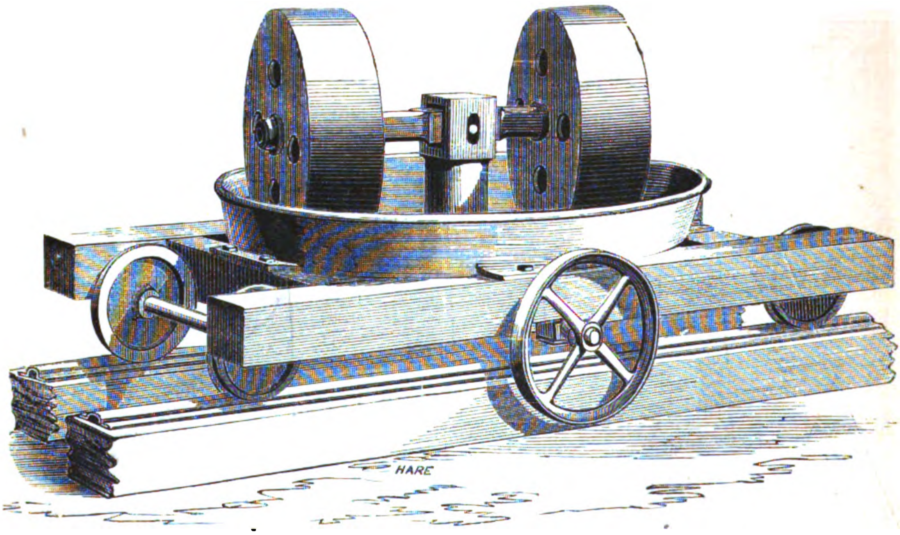
The pan is fitted with loose bottom in segments (the same as No. 1 and No. 2 Mills), and is keyed on the vertical shaft, which has a steel toe working in a suitable bottom bearing, and it is made to rotate by the gear below, as shown, or it may be driven from above if required: the rollers are usually made of cast-iron, but granite or hard stone rollers can be substituted if desired; these turn on the cross shaft with the revolution of the pan, which gives a grinding

action, and wrought-iron scrapers are placed so as to throw the stuff under the rollers.

For permanent work these Mills are usually fixed on a stone or brick foundation, but for temporary use they are frequently mounted on a strong timber frame, and they are readily transported from place to place without taking to pieces.

As the diameter of the driving pulley varies, the subjoined prices are for the Mills complete and ready for work, exclusive of the driving pulley or of the timber frame.

Diameter of pan . .	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
Price	£60 0 0	£70 0 0	£80 0 0	£95 0 0	£120 0 0



No. 2 MORTAR OR LOAM MILL.

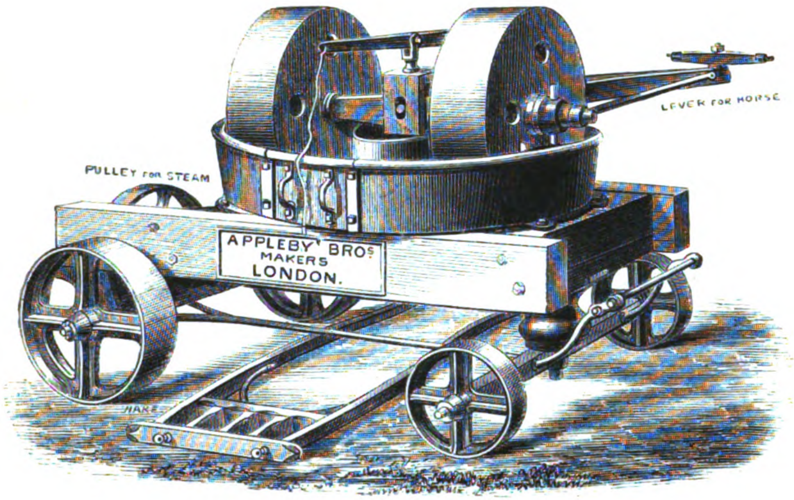
No. 2 Mill has a cast-iron pan like No. 1, but the pan is stationary, and the vertical shaft is made to rotate by gear driven from beneath the pan, and the crushing rollers revolve on a strong cross shaft, which passes through and slides in the vertical shaft, the side frames and top cross-piece being dispensed with.

This pan is frequently mounted on a timber frame with wheels, as shown in the engraving.

Price, exclusive of driving pulley or timber frame and wheels :—

Diameter of pan . . .	5 feet.	6 feet.	7 feet.	9 feet.
Price	£55	£60	£70	£95

These Mills are very strong and substantial in every part; and lighter Mills, at lower prices, may be had.

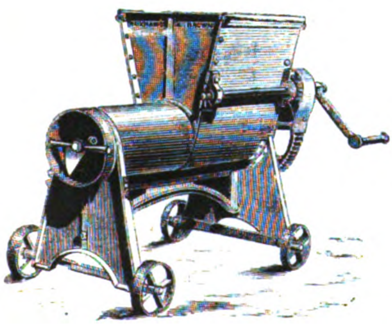


No. 3 PORTABLE MORTAR MILL,

With iron wheels, fore carriage, locking plate and shafts, horse-lever, and whipple-tree.

Diameter of pan.	4 feet.	5 feet.	6 feet.
For Horse Power . . . . Price	£65	£75	£85
Ditto ditto, and with gearing and pulley for steam power	£75	£85	£95

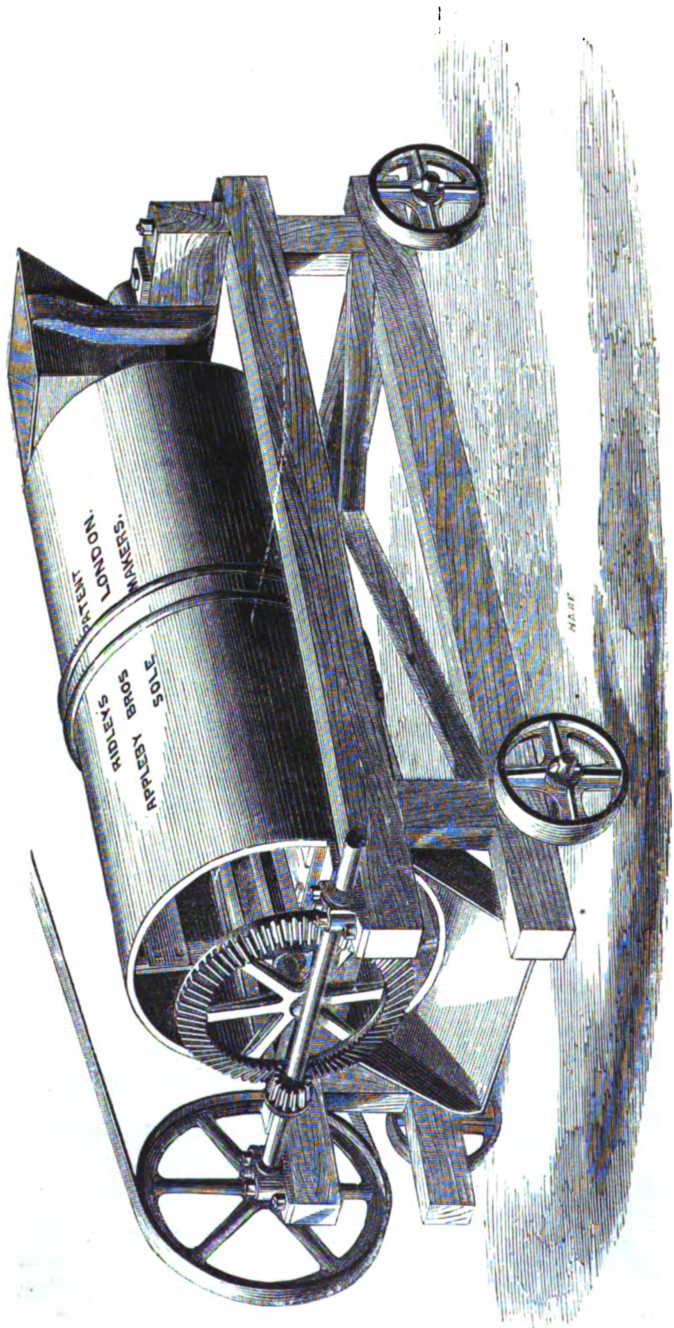
Lighter and less expensive pans are made, of which particulars may be had.



THE IMPROVED HAND MORTAR-MIXING MACHINE.

Worked by a man and a boy the machine will turn out thoroughly well-mixed mortar to supply a large number of bricklayers, masons, or plasterers, and as the quantity of water used is much less than is necessary in hand-mixing, the mortar sets quicker.

Price £7 15*s.* 0*d.*



RIDLEY'S PATENT CONCRETE MIXER,
WITH CONTINUOUS FEED AND DELIVERY.

RIDLEY'S PATENT CONCRETE MIXER.

WITH CONTINUOUS FEED AND DELIVERY.

This Machine consists of a Cast Iron Cylinder about 7′ 10″ long, which is keyed on to a central shaft, working in suitable bearings, and is driven by a belt from an Engine to the Pulley as shown, or by a belt between the flanges in the middle of the cylinder, as most convenient. The whole is mounted upon a substantial Timber or Iron Framing, with or without Travelling Wheels, as may be desired.

The Cylinder is placed at any desired inclination, according to the work to be done, and the upper end is partially open, so as to admit the materials, which may be fed in continuously at the Hopper. The interior is fitted with mixers (or shelves), running parallel with the central shaft, so that the materials to be mixed being thrown in at the elevated end, as the vessel revolves, are continually lifted up by the shelves, from which they are as continually falling, and become thoroughly mixed or incorporated together. The lower end of the Cylinder is open, and has a spout under it upon which the concrete flows in a continuous stream, and may thence be conducted without manual labour to the place where it is to be deposited, the Machine and Engine being moved forward from time to time as required.

When the Machine is driven, as shown in the accompanying engraving (which is generally most convenient), a board is fixed at the lower end to prevent the concrete splashing into the bevel gear.

The fact that this Machine is adopted by Her Majesty's Government, and that its use on the Thames Embankment is sanctioned by the Engineer to the Board of Works, and that it is used by many eminent contractors, is the best evidence of its efficiency.

About 4-horse power is required to drive the Machine, and it will turn out about 80 to 100 tons of concrete in ten hours' work.

Price as shown, but without the driving pulley, or Wheels and Axles . . £80.
Ditto, with Wheels and Axles . . . . £85.

Total weight about 4 Tons.

RIDLEY'S PATENT CONCRETE MIXER,

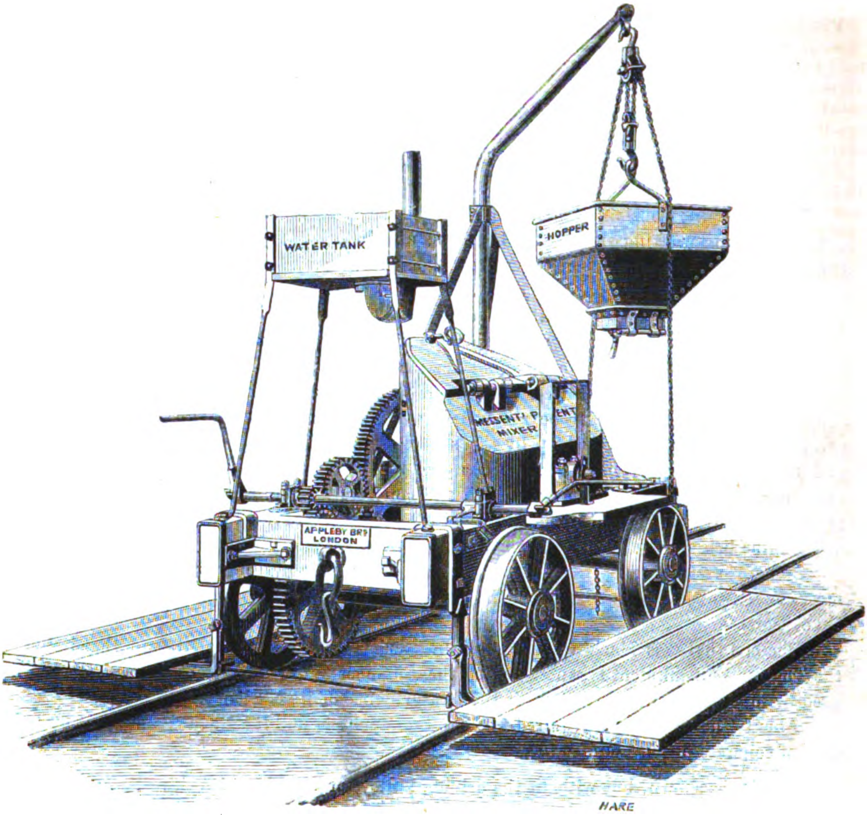
WITH SELF-ACTING FEED.

In this Machine there is a separate Hopper for each of the materials used, which are fed mechanically in any proportion required. The Engine is mounted on the same frame as the mixing Cylinder and feed apparatus, and in addition to working these, the Engine is fitted with gear for lifting the materials from Barges or Trucks, and with apparatus for moving the Machine along the road.

This arrangement of Machinery can only be used economically in situations where large quantities of Concrete are required, but in such cases the advantages obtained are :—

1st. A perfectly equal proportion of materials throughout the mass, however large it may be.

2d. Small cost of working, the mechanical arrangements being made to reduce manual labour to the minimum.



MESSENT'S PATENT CONCRETE MIXING MACHINE.

THE mixing vessel is of cast-iron, of such a shape that when half-filled with material and turned round on its axle the material enclosed is turned over (sideways as well as endways) four times by each single revolution of the mixing vessel. It is fitted with strong doors, top and bottom, and is made to revolve on its central axis by means of wheel and pinion gear, and the whole apparatus is mounted on a trolly suited to any gauge of rails, or it may have plain wheels for an ordinary road.

A swing Jib or Davit at one end of the trolly carries a Hopper which contains one charge of the materials, and a Tank at the other end contains one charge of water.

The mode of working is as follows,—the trucks carrying the materials usually run on the same line as the Mixing Machine ; the materials for one charge are filled into the hopper, which is turned over the top and is discharged into the mixing vessel into which the contents of the water tank are also emptied. The mixing vessel is then set in motion, and in about seven or eight revolutions all the materials, however irregular in form and size, are perfectly amalgamated, the door at the bottom is then opened and the vessel is emptied almost instantaneously.

Whilst this is being done the hopper and Tank are filled, and their contents are again discharged into the mixing vessel.

The working expenses are as follows:—

	£	s.	d.
Two men filling from trucks, at 3/6 per day . . .	0	7	0
Four men turning the mixing vessel, 3/6 ,, . . .	0	14	0
One Boy to attend water tank	0	1	6
	1	2	6

Practice has shown that the best charge for the hand-worked machines is half a cube yard, and this quantity is turned out every six minutes except during the changing of the empty for the full waggons, the quantity mixed per day is about forty-five yards, the cost is therefore about sixpence per cube yard. A much better result is obtained from these machines when worked by steam, but the hand-worked machines are found very economical in cost of labour, whilst the quality of the work is far superior to that obtained by the most careful and laborious hand and shovel mixing.

This Machine was specially designed by Mr. Messent to obtain a thorough mixture of materials in the large Concrete blocks so extensively used in the Tyne Piers at Tynemouth, and at the same time to dispense with the necessity of breaking to an uniform size the stones which are ready to hand of very irregular form and size, and it is found to accomplish the object for which it was designed, with great economy in time and labour.

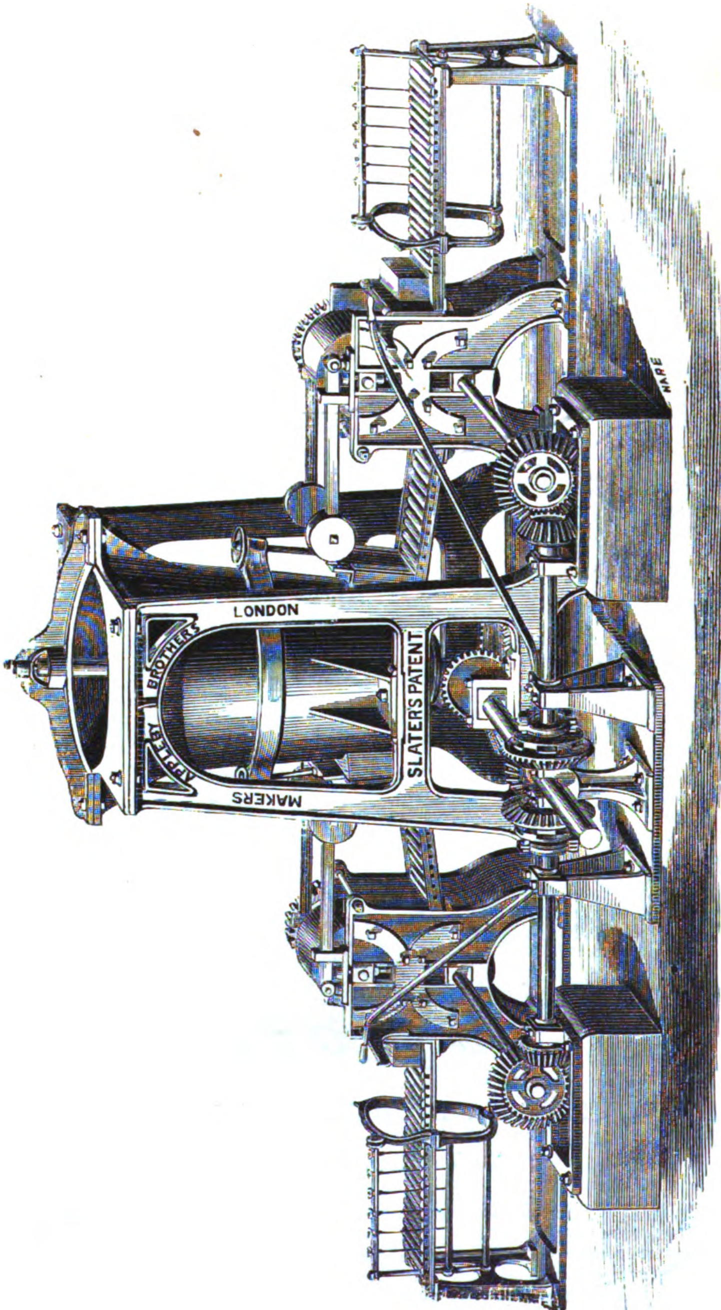
Price of the Hand Mixer on Trolly complete with gear for moving by hand £85 0 0

RIDLEY'S PATENT CONCRETE MIXER.

TO WORK BY HAND.

THE description at p. 197 will apply generally to the Hand Power Machine illustrated above. It is proportioned to carry a charge of about half a cubic yard of materials, and is adapted to run on any gauge of railway, with a platform the proper height for working; when the machine is without wheels, or fitted with plain wheels, the platform may be dispensed with. The lever on the Hopper works a slide to regulate the feed, or to shut it off entirely whilst a fresh charge is being put in; the lever in front of the machine works a disc which regulates the delivery of the mixed concrete, but the front end is usually closed whilst the charge is being mixed.

Price of the Machine, complete as shown, £50.



SLATER'S PATENT COMBINED PUGGING AND BRICK-MAKING MACHINE.

SLATER'S PATENT COMBINED PUGGING AND BRICK-MAKING MACHINE.

THE Machine illustrated on the opposite page represents a PUGGING MILL and DOUBLE BRICK-MAKING MACHINE, which pugs the clay and forms the Brick at one operation. The clay is thrown in at the top of the conical cylinder, which has a vertical shaft up the centre, and upon which are fixed a series of pugging and pressing blades; these blades prepare the clay and force it through the sliding doors at the bottom and on opposite sides of the Machine, and discharge it upon the inclined planes, formed of rollers, covered with felt or other suitable material. These inclined planes conduct the clay to the PRESSING ROLLERS, which are kept at a proper distance apart by means of sliding bearings, and instead of having a *fixed centre*, as is usually adopted, the upper roller is retained in its proper position by WEIGHTED LEVERS, which form a *self-acting apparatus* for preventing breakage to the machinery, by stones or other foreign substances being passed through with the clay; the rollers have the further effect of *tempering* or reducing the clay to a proper consistency, and forcing it through the DIES in a continuous stream on to the Table. The Machine is then stopped instantly; the stream of clay being at rest, it is cut by a WIRE CUTTING FRAME of the construction shown, which ensures the Bricks being all uniform in size and perfectly square.

The Patentee of this Machine,—being largely occupied in the manufacture of bricks, and having the most intractable description of clay to deal with,—after a lengthened experience, and the failure of other machines, has succeeded in producing this Machine, which combines great simplicity, compactness, and the total absence of straps, or other machinery liable to breakage or extreme wear and tear. When driven by a FIXED ENGINE, all that is required is a spur wheel and pinion, speeded to give about twenty-seven revolutions per minute, to the main driving shaft of the Machine; and when driven by a PORTABLE ENGINE, the only strap required is that from the Engine shaft to the pulley on the main driving shaft of the Machine. These Brick Machines are made either Single or Double-ended; and for working stiff, heavy, and strong clays, they are fitted with powerful CRUSHING ROLLERS, for reducing all hard substances.

The Machines may be seen in constant work during the season turning out at the rate of 28,000 bricks per day.

Price £300 0*s.* 0*d.*

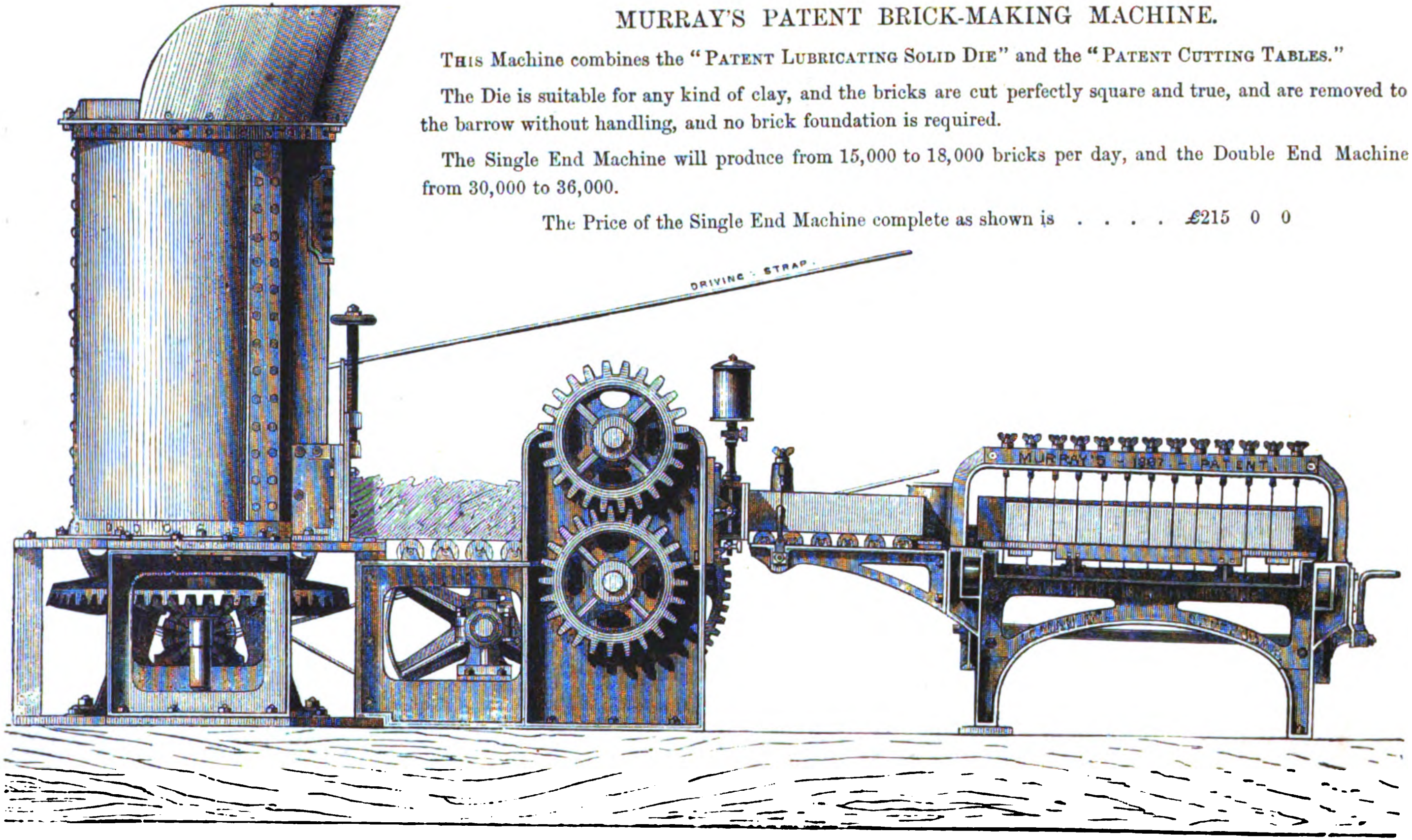
MURRAY'S PATENT BRICK-MAKING MACHINE.

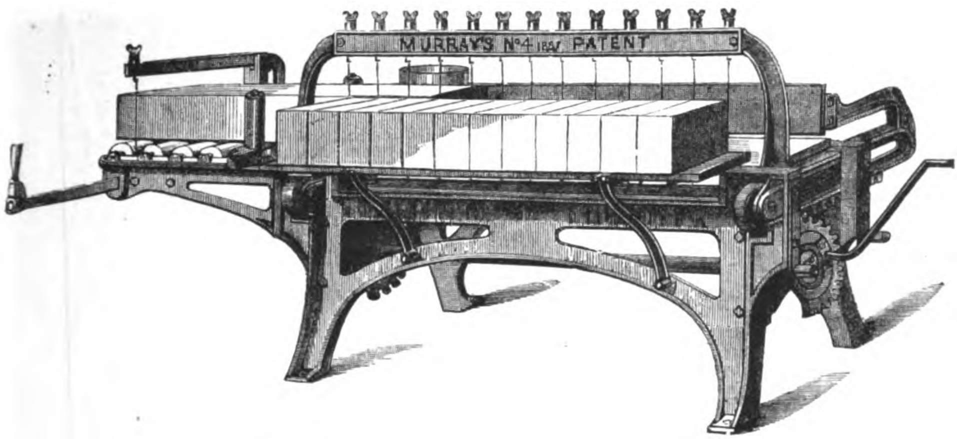
This Machine combines the "Patent Lubricating Solid Die" and the "Patent Cutting Tables."

The Die is suitable for any kind of clay, and the bricks are cut perfectly square and true, and are removed to the barrow without handling, and no brick foundation is required.

The Single End Machine will produce from 15,000 to 18,000 bricks per day, and the Double End Machine from 30,000 to 36,000.

The Price of the Single End Machine complete as shown is £215 0 0

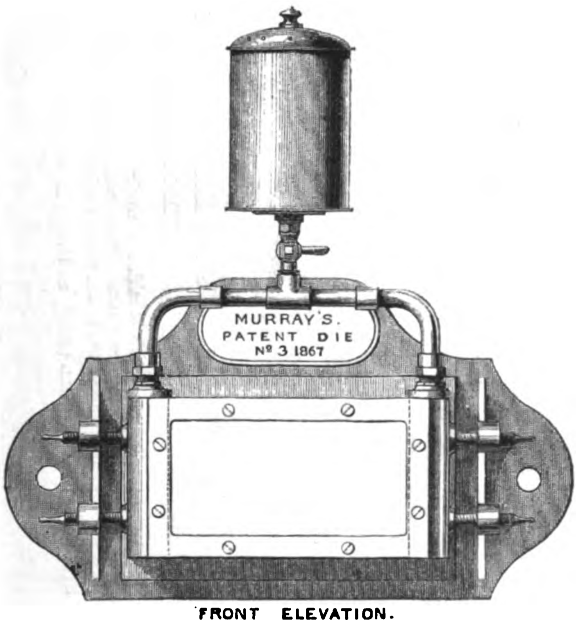




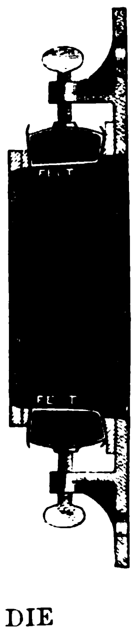
MURRAY'S PATENT CUTTING TABLE

Can be applied to any steam brick-making machine, and the advantages gained by its adoption are, that with the same number of hands, an increase of from 2,000 to 3,000 bricks per day (of 10 hours) over the ordinary cutting tables can be obtained, and the bricks cut are perfectly true. The wires can be adjusted to cut bricks either square or at any angle. No sand is required, and the wire-cutter and fustian is subject to a minimum of wear. Common oil (not exceeding 4*d.* per gallon in cost) is used for lubricating, and a pint is sufficient for 1,000 bricks. The rollers never require scraping or washing.

The price for one Cutting Table complete, to cut straight bricks, is . .	£30	0	0
Apparatus for cutting bevel bricks to any angle is extra	1	6	0



FRONT ELEVATION.

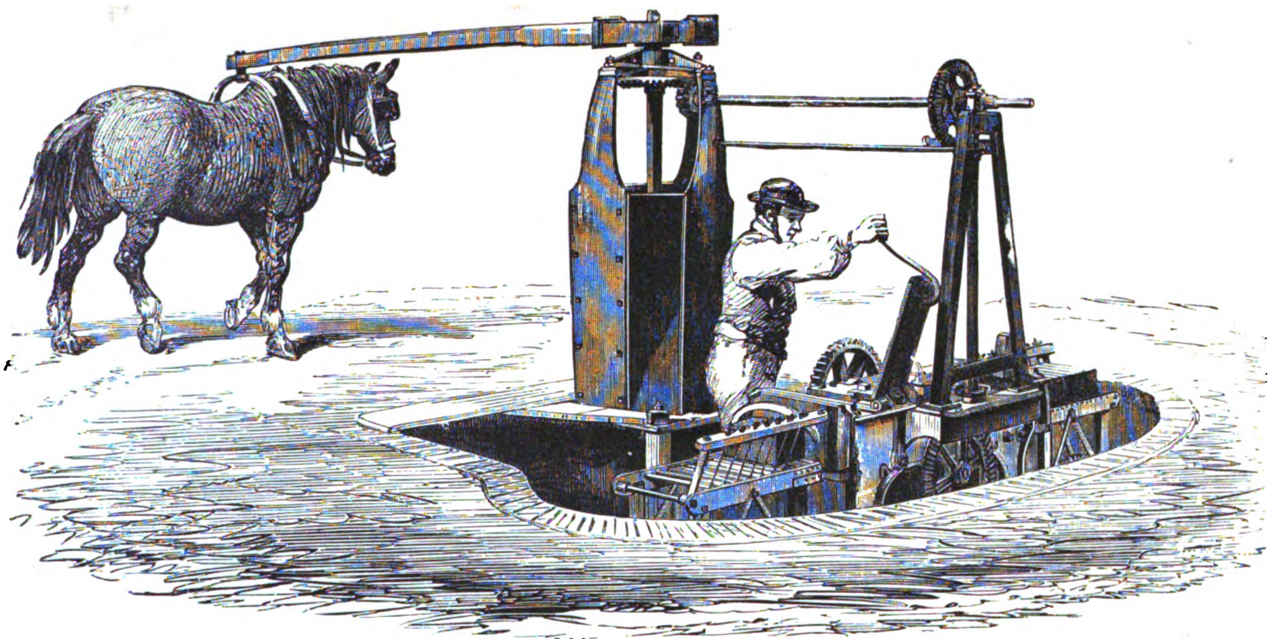


SECTIONAL PLAN

MURRAY'S PATENT LUBRICATING BRICK DIE

Is applicable for working any kind of clay. The lubricant used is either water or oil, and the corners and edges are brought out perfectly sharp and square. This Die can be used with any steam machine, and is easily applied.

Price of the "PATENT DIE" £16 0 0

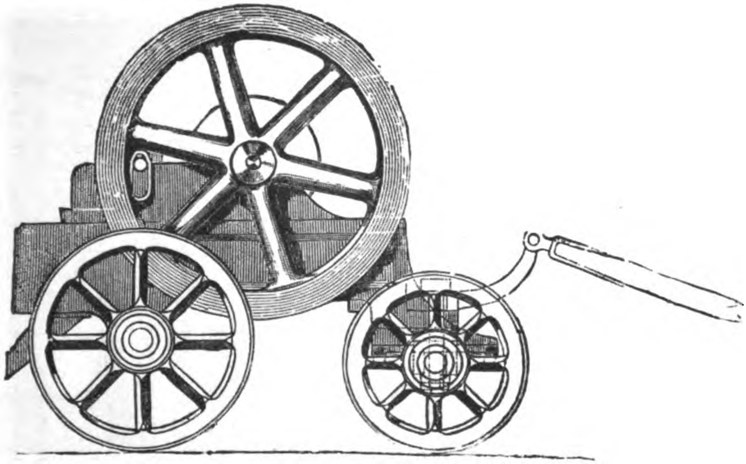


COMBINED CLAY-PREPARING, AND BRICK, PIPE, AND TILE MACHINE,

ADAPTED FOR WORKING BY ANIMAL POWER.

THE usual production of this Machine, if worked by one horse, with one man feeding and four boys carrying away, is about 6,000 solid Bricks or 12,000 two-inch Pipes in ten hours. Price, with Pugging-Mill, double-end Brick and Pipe Machine, two self-lubricating Brick Dies, two stages, connecting gear, horse-work, draw-bar, &c. complete—£70.

STRONG IRON PUG MILL (*only*), as shown in the above Engraving,	No. 1, 2 feet diameter	£12 12 0
	No. 2, 2 ,, 6 ,, ...	16 16 0



BLAKE'S STONE-BREAKER.

This machine is extensively used for breaking granite and other stones, furnace cinder, &c., to sizes suitable for road and railway ballast, making concrete, filter beds, &c., as well as for crushing ores, pyrites, sulphur stone, emery, flints, and all kinds of hard and intractable minerals.

The main shaft is made to revolve by a strap from an engine or other motive power, and from the eccentrics, motion is given through the connecting rod and the toggles to the moveable jaw. This is then moved backward and forward against the fixed jaw, and the stones or minerals to be operated upon are dropped between these jaws, which reduce the materials to any size required. The distance between the jaws at the bottom regulates the size of the broken stone, and as this can be varied, the size of the stones can be regulated to suit the special use for which they are in each case required.

The product of these machines will vary materially with the character of the stone broken, granite, most kinds of sandstone, and in fact all stone of granular structure, passing through much more rapidly than those of a more compact nature; but the kind of stone being the same, the product per hour will be in proportion to the width of the jaws, the distance between them at the bottom, and the speed. The proper speed for working is 200 to 250 revolutions per minute, and to make good road metal from compact stone the jaws should be set 1¼ to 1½ inches apart at the bottom. For softer and granular stones they should be wider apart.

The following table shows the several sizes of machines, the product per hour of each size, of fine road metal from the hardest materials when run with a speed of 250,—the power required to perform this duty,—the whole weight of each size, and the weight of the heaviest piece when separated for transportation.

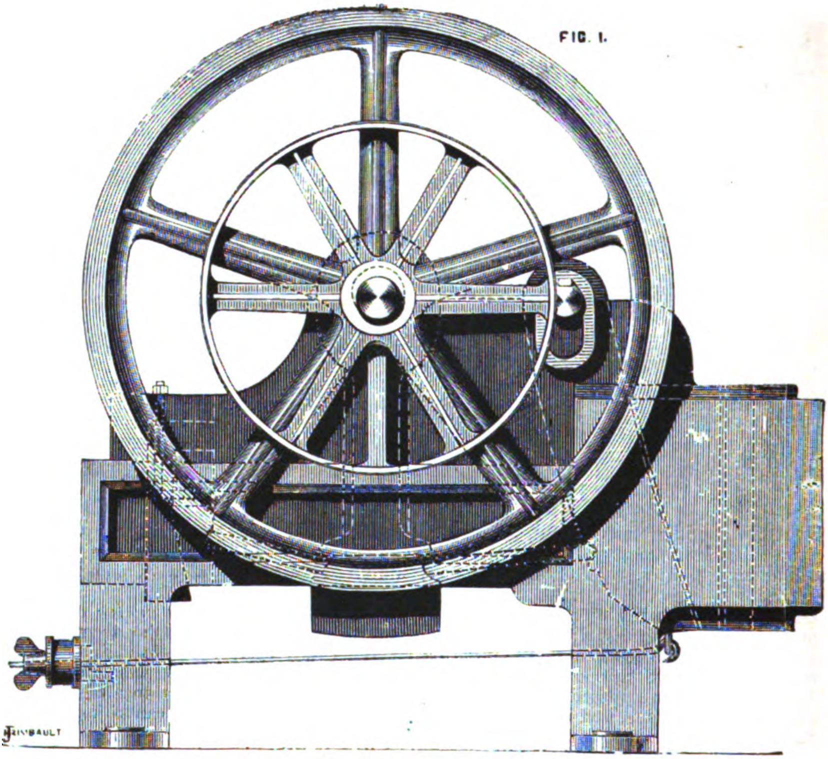
Size.	Product per Hour.	Power required.	Total Weight.			Weight of Frame.			Price Nett.			On Wheels.		
			Cwts.	qrs.	lbs.	Cwts.	qrs.	lbs.	£	s.	d.	£	s.	d.
6 by 4	1½ cub. yds	2 horse.	36	0	0	18	0	0	75	0	0	80	0	0
10 by 7	3 ,,	4 ,,	78	0	0	37	2	0	140	0	0	147	10	0
15 by 7	4½ ,,	6 ,,	108	0	0	54	0	0	180	0	0	190	0	0
20 by 9	6 ,,	8 ,,	156	2	0	74	0	0	210	0	0	255	0	0
24 by 12	8 ,,	12 ,,	376	3	0	80	0	0	350	0	0	....		

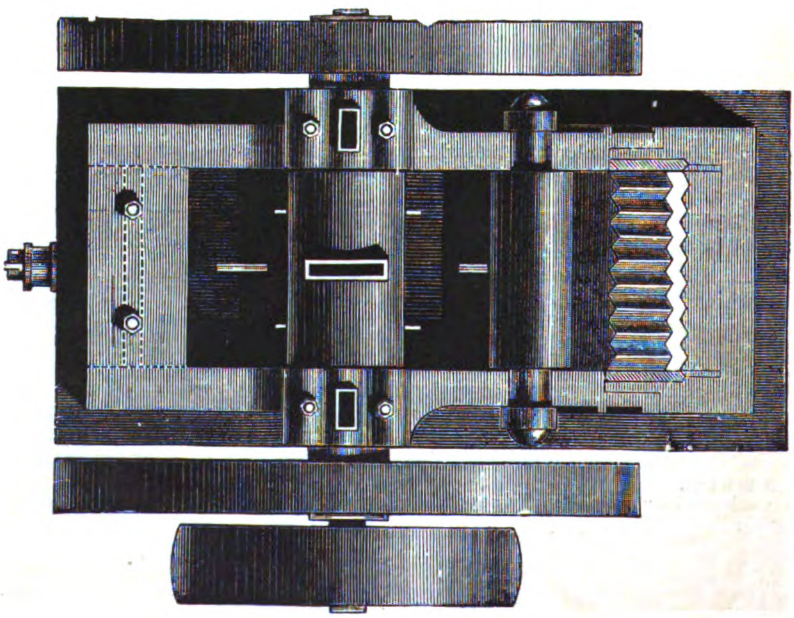
The whole length of machines varies (according to size) from 4 to 10 feet; height, 5 to 8 feet; width, 3 to 5 feet.

The machines may be driven by any power less than that given in the table, yielding a product per hour smaller in proportion.

BLAKE'S STONE-BREAKER.

FIG. 1.

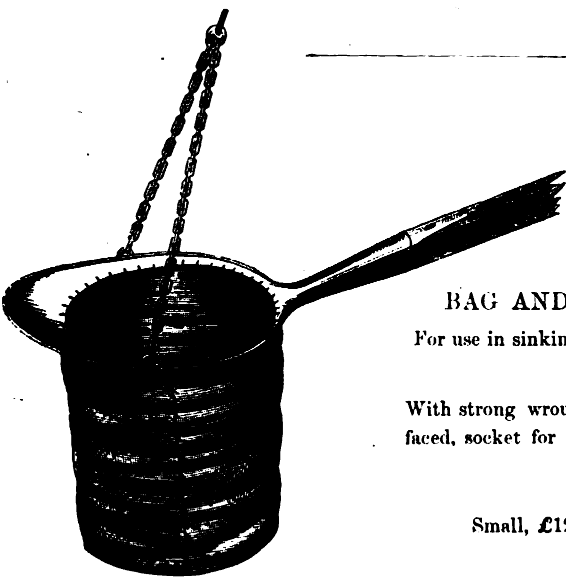




STRONG ROUND WROUGHT-IRON
CONTRACTOR'S SKIP,

With Swing Handle and Catch, and Swivel Bale.

To hold	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{3}$	1 cubic yard.
Each	£3 10 0	£5 10 0	£6 10 0	£9 5 0	£12 10 0

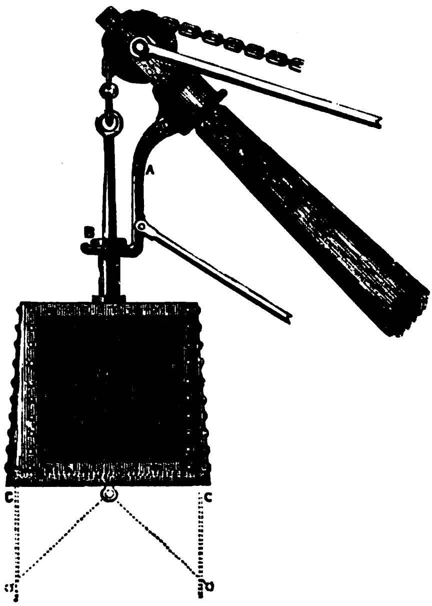


BAG AND SPOON DREDGER,

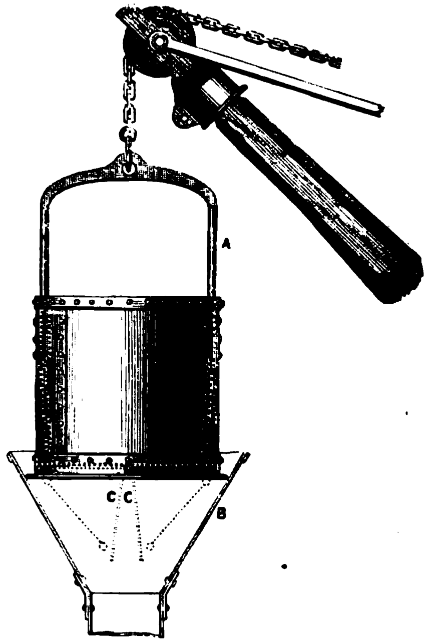
For use in sinking Cylinders, deepening Rivers, Canals, &c. &c.

With strong wrought-iron Spoon or frame, steel faced, socket for wood pole, and strong leather bag.

Small, £12 10 0 Large, £14 0 0



(No. 1) Contractor's Skip.



(No. 2) Corn, or Coal Skip.

MURRAY'S PATENT SELF-ACTING SKIPS.

APPLEBY BROTHERS, SOLE MANUFACTURERS.

These Skips are made throughout of wrought-iron, and of any required shape or size. They have been specially designed for lifting ballast, corn, coal, or other materials, and their principal advantages over the Skips ordinarily in use are—

1st. Greater safety in working.

2d. Greater expedition in discharging.

3d. That they can be discharged without manual labour at any height or depth.

4th. That they will stand in any position where they are left.

Square Skips (No. 1) to hold—

¼ cubic yard	= about 6½ cubic feet,	or say about	6½ cwt.	price each	£7	15s.
⅓ „	= about 9	„	9 cwt.	„	£8	15s.
½ „	= about 13½	„	13 cwt.	„	£9	5s.
⅔ „	= about 18	„	18 cwt.	„	£10	0s.
1 „	= about 27	„	26 cwt.	„	£12	0s.

These sizes are usually kept in stock, but any other size can be made to order in a short time.

The mode of working No. 1 Skip is as follows:—A light rod from the fork A is carried to the attendant's hand, and when the Skip is in the proper position the fork A is thrown under the flange B, and the chain is slacked; the doors forming the bottom of the Skips then fall down and assume the position shown in the dotted lines C C, when the contents of the Skip are instantaneously discharged. When the fork is drawn back, the doors (forming the bottom) close, and they will obviously remain closed so long as the Skip is suspended (unless they are purposely opened), or when it is deposited on the ground.

FOR LAYING CONCRETE UNDER WATER this apparatus is invaluable. A pair of light doors fitted to the top of the ordinary Skip convert it into a *close box*, in which the concrete is lowered undisturbed by currents to any required depth, and by this means concrete can often be put down in situations where, without such appliances, expensive "boxes" or dams would be indispensable. For this purpose a light chain or rope is used instead of the fork A: one end is made fast to the jib head, and the other end to the flange B. The length of this chain or rope is of course regulated by the depth of working, and when this depth is reached the contents of the Skip are discharged in the same way as if the fork were thrown under the flange. If the jib is "radiated," or swung at the same time as the contents are being discharged, the concrete can be levelled at any depth as well as if "trimmed" by hand.

No. 2 Skip is the same price, and is similar in principle to No. 1, excepting that the bottom doors are hung across the centre instead of at the sides, and that the fork and rod A are not required. When the Skip is lowered upon the hopper B, and the lifting chain is allowed to run out, the doors C C fall down, and the contents of the Skip are discharged into the hopper, and are conducted in any direction by the outlet pipe or "shoot."

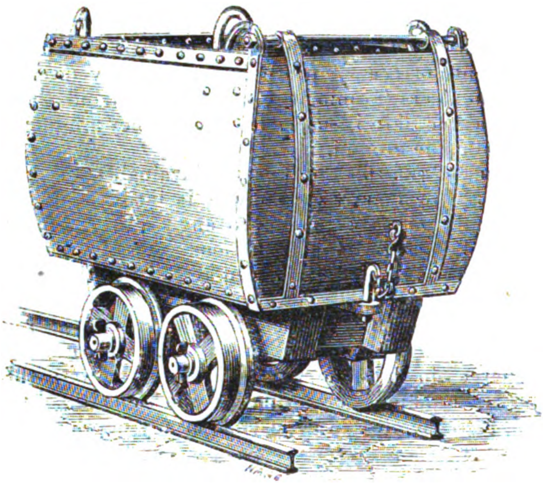
From the foregoing description it will be evident that these Skips can be economically used for a great variety of purposes, and that the objection to the self-acting opening apparatus is entirely obviated in this arrangement. They are certainly safer and quicker than the swing Skips, which are only held by a small catch, liable to slip, and require an extra "hand" to lift this catch and "tip" the Skips, and they are considered more convenient than any other appliance of a similar nature.

WOODFORD'S PATENT SELF-ACTING SKIPS

Are of wrought-iron with circular bottoms, which discharge their load when the chain is slacked out, in the same manner as shown and described for Murray's Patent Skips. The prices are, for Skips to contain

$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{3}$	1 cubic yard.
£7 15*s*.	£8 15*s*.	£9 5*s*.	£10	£12 each.

No. 1. WROUGHT-IRON COLLIERY WAGGON.



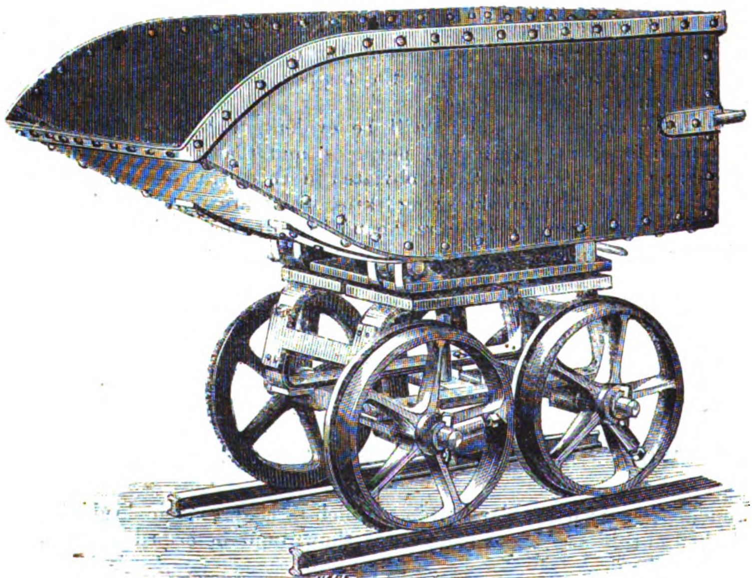
THESE waggons are made various sizes and gauges of rails; they are with cast-iron wheels about 12 inches diameter, wedged fast on to the axles which run loose on the carriages, and are without doors, being emptied by a "tippler" or "teaming cradle." The usual sizes are—

To hold about 6 cwt.
3 ft. long × 2 ft. 6 broad × 2 ft. deep;

And to hold about 8 cwt.
3 ft. 6 long × 2 ft. 10 broad × 2 ft. deep.

Weights from 1¼ to 2 cwt. and prices from £3 10s. to £6.

Teaming cradles for these waggons, weight from 4 to 5 cwt. and the price is from 35/0 to 40/0 per cwt.

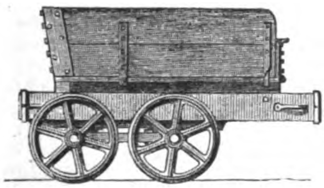


No. 2. IRON EARTH WAGGON WITH TURN-TABLE BODY.

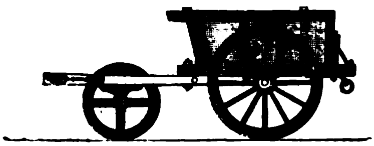
To hold about a yard and a half of earth, with framework as shown, and turn-table to tip, and discharge either end-way or side-way. Price £7 to £9, according to strength of iron and gauge of rails.

Many waggons are made on a similar but somewhat simpler plan, with wood frame and coup and wheels fast on to the axles, from £5 to £6 each, but the prices depend entirely on the quantity and the specification.

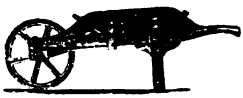
CONTRACTOR'S WAGGONS.



CONTRACTOR'S TIP WAGGON.



DOBBIN CART.

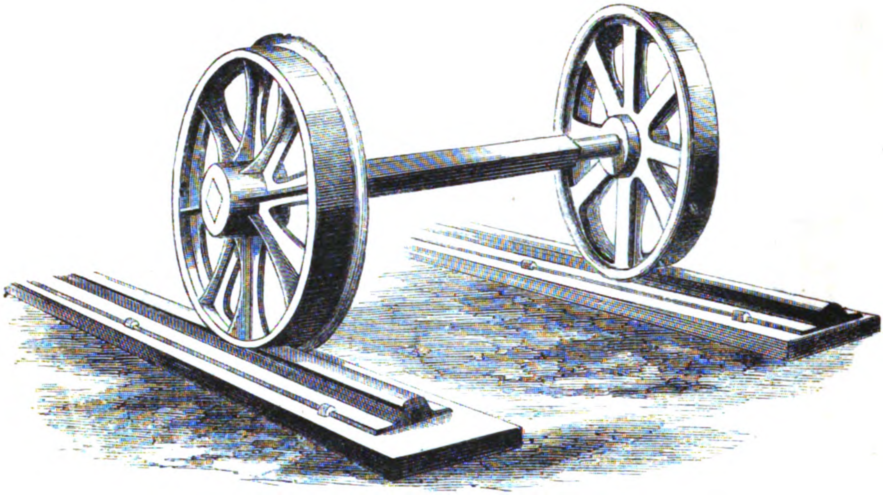


WOOD WHEELBARROW.

		£	s.	d.
STRONG END OR SIDE TIP WAGGON, for Contractors' use, with elm framing, cast iron wheels and wrought iron axles	each	£18	0	0
If with wrought iron body	,,	24	0	0
CONCRETE WAGGON, elm frame, wrought iron body, cast wheels and wrought axles, the bottom made to divide and open outwards	,,	21	10	0
BRICK, LIME, or SAND-BOX WAGGON, elm throughout, cast wheels, and wrought axles, both sides are made to fall down	,,	18	0	0
If any of the above waggons are fitted with flanged wrought iron wheels £7 10s. extra.				
CONTRACTORS' DOBBIN CARTS	,,	12	15	0
CONTRACTORS' or NAVIGATORS' WOOD WHEELBARROWS, with cast iron wheels	,,	0	13	6
Ditto, with wrought iron wheels	,,	0	16	0
If packed for export add 1/0 each.				
WROUGHT IRON FRAMED WHEELBARROWS, painted black	,,	1	6	0
Ditto, galvanized	,,	1	12	0
RAILWAY LORRYS with India rubber tyres for platform use	,,	9	5	0
RAILWAY FISH TRUCKS	,,	12	5	0
NAVIGATOR'S WOOD HUTS, 28 x 16 feet	,,	36	0	0
WORKMAN'S WOOD HUTS, 28 x 16 feet, a better quality, with partitions	,,	50	0	0
CONTRACTOR'S ORDINARY PILE-DRIVING MACHINE for HAND POWER, the Woodwork of the pile engine 40 feet high, complete, with single purchase crab or winch, chain, nippers or catch, and cast iron monkey up to 20 cwt. or less if required. The design is generally similar to that shown for the "STEAM PILE-DRIVING MACHINE," illustrated at page 34.	,,	44	0	0
The same machine 30 feet high, complete as above	,,	40	0	0

IMPROVED PILE SHOES for ordinary Piles or for Sheet Piles, with cast iron points and wrought iron straps, which may be either fast or loose for convenience of carriage. The prices vary according to quantity, size, &c. from 10/0 to 13/0 per cwt.

Ordinary cast or wrought iron Points for Piles vary in price for the same reasons.



CONTRACTORS' WHEELS AND AXLES, AND CARRIAGE WHEELS AND AXLES.

These articles vary much in weight and price, according to the size and pattern selected, and the width of gauge and quantity ordered.

Ordinary Contractors' 2 ft. 6 in. cast-iron Wheels, and wrought-iron axles, wedged fast on to the Wheels, and for 4 ft. 8½ in. gauge of rails, are worth about £7 per set and upwards, but this price may be modified according to circumstances, or they may be purchased, if desired, at per ton, instead of per set.

Ordinary 2 ft. 6 in. wrought-iron Wheels, and 3 inch round axles for 4 ft. 8½ in. gauge, are about £14 per set and upwards.

Permanent-way wrought-iron Wheels and Axles vary in prices and weights even more than Contractors' Wheels, but may be estimated to cost, for 4 ft. 8½ in. gauge,

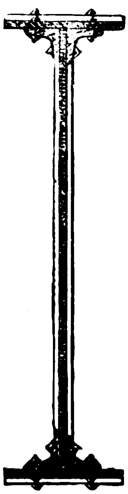
3 ft. Wheels and Axles, from £17 to £50 per set.
3 ft. 6 in. " " £23 to £55 "

according to specification and quantity.

Chilled cast-iron Tram Wheels for Contractors or Collieries, price £10 per ton, and upwards.

Pulley or Sheave patterns, for Flat or Round Rope, Chain, &c. in great variety.

Railway Waggon and Carriage Iron Work.



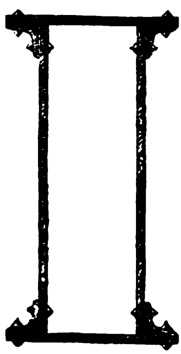
WROUGHT-IRON RIVETTED GIRDERS

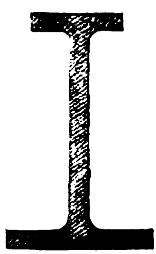
Are made to drawing or specification from about £15 per ton.

Cast-Iron Girders from about £7 per ton.

Rolled Wrought-Iron Girders from about £10 per ton.

Wrought-Iron Fire-proof Doors, Shutters, &c. from about £20 per ton.





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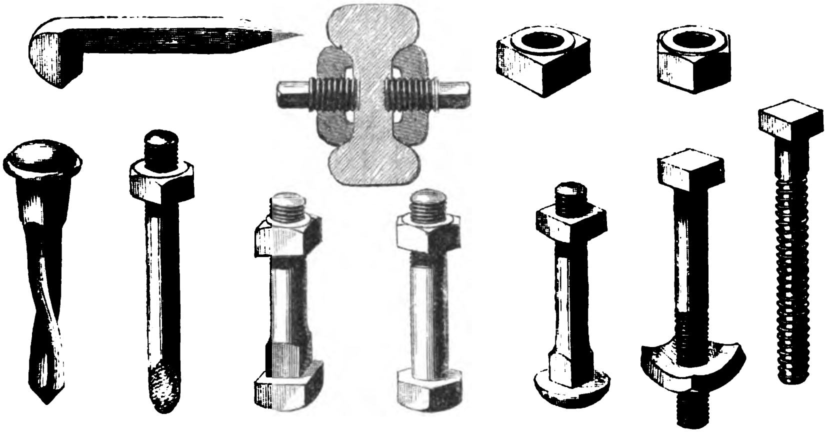


10 6 2 1 3 4 5

WROUGHT IRON BOLTS AND NUTS,

SCREWED TO WHITWORTH'S STANDARD THREAD.

With Hexagon (1), Rose, Countersunk, or Square (2) Heads, and Hexagon or Square Nuts.

Diameter of Bolt.	7/16		½		⅝		¾		⅞		1		1⅛		1¼		1⅜		1½ dia.	
Length.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
1¼ to 1¾ inches.........per cwt.	31	9	31	0	26	3	25	6	25	6	...		...		...		...		...	
2 to 2¾ — .... —	31	0	30	0	25	0	24	6	24	6	24	6	24	6	24	6	...		...	
3 to 4 — .... —	30	0	29	0	24	6	23	6	24	0	24	0	24	0	24	0	24	0	24	0
4 to 5 — .... —	...		26	9	24	0	22	9	22	6	22	6	22	6	22	6	22	6	22	6
5 to 6 — .... —	...		26	3	23	6	22	3	21	9	21	9	21	9	21	9	21	9	21	9
6 to 8 — .... —	...		25	6	22	3	21	3	20	6	20	6	20	6	20	6	20	6	20	6
8 to 10 — .... —	...		25	0	21	9	20	6	20	0	20	0	20	0	20	0	20	0	20	0
10 to 12 — .... —	...		24	6	21	3	20	0	19	6	19	6	19	6	19	6	19	6	19	6
12 to 14 — .... —	...		24	0	20	6	19	6	19	0	19	0	19	0	19	0	19	0	19	0
14 to 16 — .... —	...		23	6	20	0	19	0	18	3	18	3	18	3	18	3	18	3	18	3
16 to 18 — .... —	...		22	9	19	6	18	6	17	9	17	9	17	9	17	9	17	9	17	9

If with square necks, 1s. 8d. per cwt. extra. If with hexagon nuts, 1s. 8d. per cwt. extra.

AVERAGE PRICES AT PER GROSS FOR BOLTS AND NUTS AS SPECIFIED ABOVE, USED BY ENGINEERS, &c.

Diameter of Bolt.	¼		5/16		⅜		7/16		½		9/16		⅝		¾		⅞		1 in.	
Length.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
1¼ inches ....per gross.	4	8	5	6	6	4	7	6	9	0	14	0	15	8	22	6	31	6	44	3
1½ — .... —	4	8	5	6	6	4	8	3	10	3	15	3	16	3	23	6	33	6	48	0
1¾ — .... —	4	8	5	6	6	4	8	9	10	6	15	9	16	6	24	0	35	3	49	3
2 — .... —	5	3	3	3	7	6	9	3	10	9	16	0	16	9	24	6	35	9	49	6
2¼ — .... —	5	3	6	3	7	6	10	0	11	3	16	9	17	0	25	0	37	3	49	9
2½ — .... —	5	3	6	3	7	6	10	3	11	9	17	6	17	9	25	6	39	0	51	0
2¾ — .... —	5	3	6	3	7	6	10	6	12	6	19	3	18	4	26	0	40	9	52	8
3 — .... —	6	5	7	3	9	3	10	9	13	0	19	6	19	6	26	9	41	6	53	3

If with square necks, ¼ and 5/16, 4*d.* per gross extra; ⅜, 7*d.* per gross extra; above ⅜, 1*s.* 8*d.* per cwt. extra.
If with hexagon nuts, ¼, 5/16, and ⅜ diam. 10*d.* per gross extra; other sizes, 1*s.* 8*d.* per cwt. extra.

Machine-made Nuts, Hexagon (11) and Square (7), made and tapped to Whitworth's Standard Gauges and Thread.

	THICKNESS OF NUTS.										
Dimensions of Nuts . .	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$	In.
Size of Hole	$\frac{5}{16}$	$\frac{13}{32}$	$\frac{17}{32}$	$\frac{5}{8}$	$\frac{23}{32}$	$\frac{27}{32}$	$\frac{31}{32}$	$1\frac{1}{16}$	$1\frac{3}{16}$	$1\frac{9}{32}$	,,
Diameter across Flats .	$\frac{11}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{11}{16}$	$1\frac{7}{8}$	2	$2\frac{3}{16}$	$2\frac{7}{16}$	,,
Diameter of Angle . .	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	,,
No. of threads to the in.	16	12	11	10	9	8	7	7	6	6	
No. of nuts to the cwt.	3584	1433	796	477	358	224	171	128	100	75	
	PRICE PER GROSS.		PRICE PER CWT.								
Hexagon Nuts Untapped	2/3	3/4	28/6	27/3	26/0	25/6	25/6	25/6	25/6	25/6	
,, Tapped .	3/4	4/6	33/6	32/3	31/3	30/0	29/6	29/6	29/6	29/6	
Square Nuts Untapped.	1/8	2/6	22/3	22/3	21/0	20/0	20/0	20/0	20/0	20/0	
,, Tapped . .	2/9	3/8	27/3	27/3	26/3	24/6	24/0	24/0	24/0	24/0	

Nuts if made thicker or thinner will be *extra.*
Finished Nuts, *Bright,* at double the above prices.
Note—The thickness of Nut equals the *diameter of Bolt.*

No. 6. Bolt Ends screwed 4 inches, with Square Nuts—
$\frac{1}{2}$ $\frac{5}{8}$ $\frac{3}{4}$ to $1\frac{1}{2}$ inch diameter.
Price 17/9 16/9 15/6 per cwt.
Hexagon Heads 1/2 per cwt. extra.

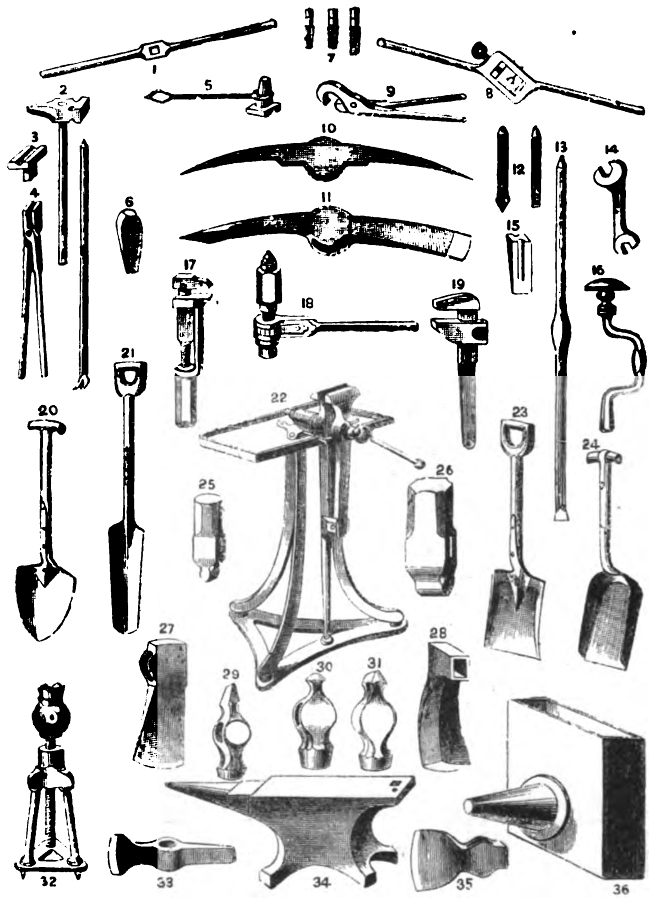
No. 5. Coach Screws	$\frac{3}{8}$ & $\frac{7}{16}$	$\frac{1}{2}$ & $\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$ & $\frac{13}{16}$	$\frac{7}{8}$ & 1 inch diameter.
	32/6	29/0	25/6	25/0	24/0	23/6 per cwt.

Coach Screws in large quantities, special prices quoted.
Fish (3) and Fang (4) Bolts, ditto.
Railway Spikes and Dogs (9 and 10), various patterns, ditto.
Right and left hand Screws for Fish-plates (8), ditto.
Carriage and Waggon Bolts, in sets.
Set Pins.—Rivets, all kinds.
Wood Screws and Stove Screws, all kinds and sizes.

STEEL COLLARED FANG BOLTS FOR STEEL RAILS (APPLEBY'S PATENT),

USED THROUGHOUT THE WHOLE OF THE METROPOLITAN RAILWAY SYSTEM.

Prices, &c. may be obtained on application to the Patentees.



ENGINEERS', CONTRACTORS', AND SMITHS' TOOLS

AND WORKING PLANT.

No.	1.	Double-handled Tap Wrench. (See Screw Stocks and Dies.	
,,	2.	Ship-carpenters' Pin Maul	5*d.* per lb.
,,	3 & 5.	Smiths' Swage Tools	4½*d.* ,,
,,	4.	,, Tongs	4½*d.* ,,
,,	6 & 15.	Iron Wedges	3*d.* ,,

Nos. 7 & 8.—Screw Stocks and Dies. See pages 256 to 261.

„ 9.—Pipe Tongs . . . . $4\frac{1}{2}d.$ per lb.

„ 10 & 11.—Picks and Mattocks, well steeled at both ends . . . . . . $3\frac{3}{4}d.$ „

„ 12.—Cast Steel Chisels (for Iron) . . . . 8*d.* „

„ 13.—Crow Bars, well steeled . . . . 2*d.* „

„ 14.—Double-ended wrought-iron spanners—

Length . .	$4\frac{1}{2}$	$5\frac{1}{2}$	7	9	11	13	15	17	19 inches.
Span . .	$\frac{1}{4}$ & $\frac{3}{8}$	$\frac{3}{8}$ & $\frac{1}{2}$	$\frac{5}{8}$ & $\frac{3}{4}$	$\frac{7}{8}$ & 1	$1\frac{1}{8}$ & $1\frac{1}{4}$	$1\frac{3}{8}$ & $1\frac{1}{2}$	$1\frac{5}{8}$ & $1\frac{3}{4}$	$1\frac{7}{8}$ & 2	$2\frac{1}{8}$ & $2\frac{1}{4}$ „
Price, each.	2/3	2/9	3/6	4/6	5/6	6/6	7/6	8/6	9/6 each.

Length . .	21	23	25	27	29	31	33	36 inches.
Span . .	$2\frac{3}{8}$ & $2\frac{1}{2}$	$2\frac{5}{8}$ & $2\frac{3}{4}$	$2\frac{7}{8}$ & 3	$3\frac{1}{8}$ & $3\frac{1}{4}$	$3\frac{3}{8}$ & $3\frac{1}{2}$	$3\frac{5}{8}$ & $3\frac{3}{4}$	4 & $4\frac{1}{4}$	$4\frac{1}{2}$ & 5 „
Price, each.	10/6	11/6	12/6	13/6	14/6	15/6	17/	18/ each.

No. 14.—Double-ended patent malleable iron spanners, all sizes, 8*d.* per lb.

„ 15.—Wrought iron wedges (and see No. 6), 3*d.* per lb.

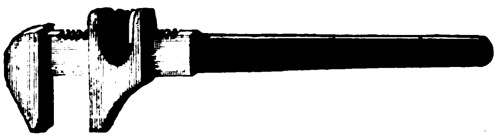
„ 16.—Best wrought iron brace, with lignum vitæ head, 7/6; without head (for using with a drill cramp, 6/8 each.

„ 16.—Second quality ditto with head, 7/; or without head, 6/ each.

„ 17.—Best strong wrought-iron Coach Wrench—

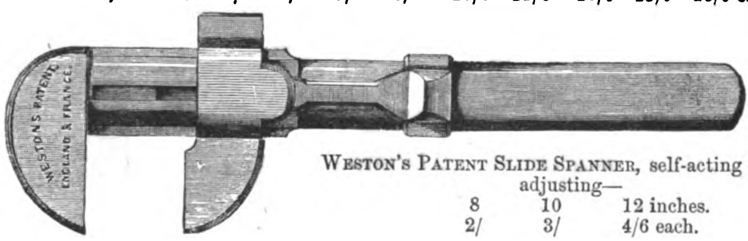
Length	10	12	14	16	18 inches.
Price each . . .	3/8	4/6	5/3	6/6	8/

„ 18.—Ratchet Braces (see page 263), various kinds.



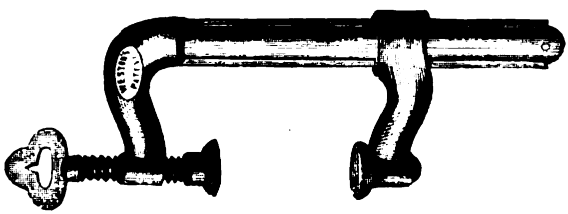
„ 19.—Budding's Patent Shifting Spanner—

Length . .	7	9	10	12	14	16	18	20	24 inch
Range . . .	1	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$ „
Price, each .	5/0	6/6	7/0	8/0	10/0	11/0	13/0	15/0	18/0 each.



Weston's Patent Slide Spanner, self-acting and self-adjusting—

8	10	12 inches.
2/	3/	4/6 each.



Weston's Patent self-adjusting Cramp—

No.	1	2	3
Span	4	6	8 inches.
Price	2/6	5/6	9/0 each.

TOOLS FOR RAILWAY, CONTRACTORS, AND GENERAL PURPOSES.

Shovels, Best Tyne Made—	No. 0	1	2	3	4	5	6	
No. 20.—Round or "Gravel" Shovels, with Crutch Handles . .		27/6	29/3	31/6	33/9	36/0		per doz.
No. 23.—Square, or "London" Shovels, with Box Handles . . .	24/9	26/0	27/0	28/9	30/6	32/0		,,
No. 24.—Stoking Shovel, with Crutch Handles, Strapped . . .		10 in. 38/3		10½ in. 40/6	11 in. 43/0			,,

Shovels of good ordinary quality, marked A. B.—

	No. 0	1	2	3	4	5	6	
No. 20.—Round, or Gravel, with Crutch Handles		26/0	27/6	29/6	31/0	32/6	34/6	,,
No. 23.—Square, or "London" Shovels, with Box Handles . . .	23/0	24/6	26/0	27/6	29/6	31/0	32/6	,,
No. 21.—Casting Tools, Crutch Handle		31/0	32/6	34/6	36/0			,,

A commoner quality at 10 per cent. less.

No. 22.—Portable Cast Iron Work Bench, with solid Box Cotter Key Vice, 4-in. Jaws, £2 4s.

Strong Pillar Work Bench, mounted on Wheels complete, and with best warranted solid Box Vice—

Size . .	4½	5	5½	6 inches wide in Jaws.
Price . .	£3 9 0	£3 15 0	£4 2 0	£4 14 6 each.

Improved Portable, all Wrought Iron, strong square Vice or Work Bench, fitted complete with best solid Box Vice, 6-in. Jaws, with Tool Chest underneath, and mounted on four Wheels, Price £5 10s. 0d.

No. 22.—Vices.	Best bright staple, with patent wrought iron solid boxes,	5½d.	per lb.
	Ditto, black ditto ditto ditto	5d.	,,
	Bright staple, brazed boxes	5½d.	,,
	Black ditto ditto	4¾d.	,,

Patent Parallel Vices—

4	4½	5	6	7	8 in. Jaws.
£2 5 0	£2 7 6	£2 10 0	£3 15 0	£5 0 0	£6 5 0 each.

No. 25, 26, 29, 30, 31.—Hammers for Engineers, Mechanics, Smiths, &c. at 6d. per lb.

No. 27 & 35.—Axes, all kinds, Steel Polled 6d. and 6½d. ,,

No. 33. Ditto for Stone Masons 6d. ,,

No. 28. Adzes for Carpenters, &c.

No. 32. Lifting Jacks (see page 219).

No. 34. Anvils, best warranted, 34/0 per cwt.

No. 36. Tuyere Iron and Cistern—

No. 1. with 21-inch Cistern and 12-inch Tuyere, 40/0 each.
No. 2. ,, 24 ,, ,, 18 ,, ,, 50/0 ,,

SMITH'S BELLOWS, best warranted, extra leathered and double nailed—

Size . .	20	22	24	26	28	30	32	34	36 inches.
Price . .	21/6	26/6	30/6	36/6	43/0	52/0	62/0	78/0	112/0 per pair nett.

New Pattern Smiths' Bellows, with REVERSIBLE PIPE, for economising space in packing for export, about 20 per cent. extra to the above prices.

Commoner qualities of Bellows at lower prices, but they are not recommended.

PATENT CIRCULAR BELLOWS, mounted in Wood Frames, SINGLE BLAST—

Size	20	22	24	26	28	30	32	34	36 inches.
Price of Bellows	43/0	54/6	59/0	72/0	88/0	100/0	118/0	140/0	163/0 per pair.
Wood Frames .	26/0	26/6	27/6	28/0	29/0	29/6	30/6	31/0	32/0 each.

PATENT CIRCULAR BELLOWS, mounted in Iron Frames, complete, DOUBLE BLAST—

Size . . .	20	22	24	26	28	30 inches diameter.
Price . . .	95/0	111/0	127/0	143/0	166/0	193/0 complete, nett.

If with weights, extra nett.

Quarry Mauls @ 4½d. per lb.

Earth Rammers 3/6 each.

Contractors' Carts, Waggons, and Barrows (see page 211).

Trollies for Platelayers.

Wheelbarrow Wheels, Wrought Iron.
Ditto ditto Cast Iron.

Sundry Plate-layers' Tools, Jim Crows, or Permanent Way Cramps for lifting or straightening Rails @ 7*d.* per lb.

Rail Straightening Machine, mounted on wood frame, wheels and axles £18 10 0
Ditto ditto the ironwork only, and without wheels or axles £11 0 0

Drill Cramps (see page 265).

Rail Gauges, 7*d.* per lb.

Plate-layers' Adzes, 10/6 each.

Railway Levers for lifting or setting Rails, of strong timber, shod with iron—

9 feet.	10 feet.	12 feet long.
25/0	28/0	32/0 each.

Mauls, the heads of hard wood hooped with iron, handles of Ash, 12/0 each.

Fish Joint Spanner and Holder, 6/0 per pair.

	9	10	12	14 inch.
Spirit Levels, plated on one side	3/8	4/0	4/8	5/6 each
Ditto plated on both sides	4/10	5/4	6/4	7/4 ,,

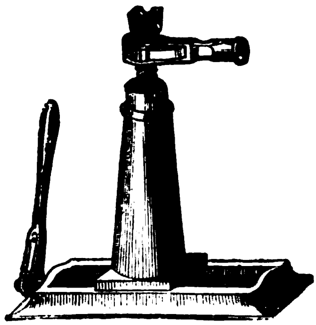
Wood Straight Edges, 5*d.* per foot run.
,, Measuring Rods, English measures, 2/9 per foot run.
,, Ditto English and French ,, 4/0 ,, ,,

Creosoting Apparatus, complete, with Tanks, Pumps, Pipes, &c. £16 10 0

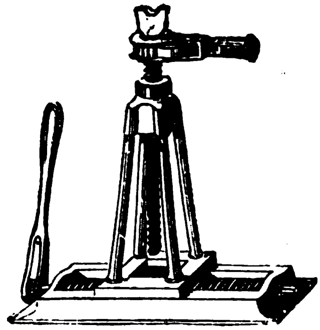
Contractors' Locomotives.

Smiths' Work and Forgings (see pages).

Bolts and Nuts. Bolt Ends (see pages 213 and 214).



No. 1.

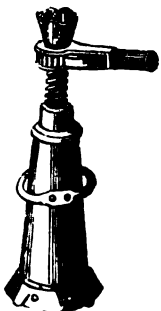


No. 2.

(Nos. 1 & 2.) TRAVERSING SCREW JACKS.

(WITH DOUBLE RATCHET LEVER TO MAIN SCREW).

Height when down.		Will Traverse.		Will Lift.		Prices. £	s.	d.
20 inches	...	6½ inches	...	6 tons	...	6	10	0
26 "	...	12 "	...	12 "	...	7	15	0
27 "	...	16 "	...	15 "	...	9	15	0
27 "	...	22 "	...	20 "	...	12	5	0



No. 3.

(No. 3.) RATCHET SCREW JACK.

Height when down. Inches.	Will Lift. Tons.	Prices. £	s.	d.
21 ...	6 ...	3	17	6
24 ...	8 ...	4	10	0
27 ...	10...	5	7	6
30 ...	12...	6	10	0

(No. 4.) BOTTLE JACK

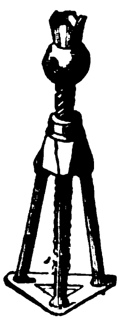
(WITH CAST-IRON FRAME).

Height when down. Inches.	Will Lift. Tons.	Prices. £	s.	d.
12 ...	1½ ...	0	17	6
15 ...	2 ...	1	0	0
18 ...	4 ..	1	2	6
21 ...	5 ...	1	6	0
24 ...	6 ...	1	10	0
24 ...	8 ...	2	0	0
24 ...	10 ...	2	10	0

No. 4.

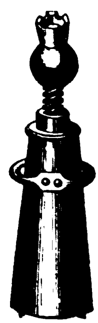
(Nos. 5 & 6.) TRIPOD AND BOTTLE JACKS.

(OR COTTON SCREWS).

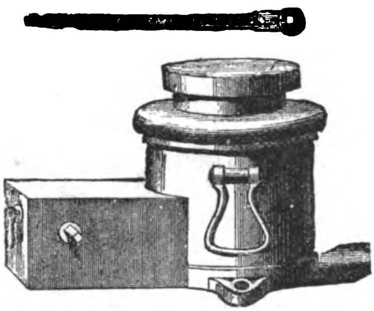


TRIPOD JACK. No. 5.

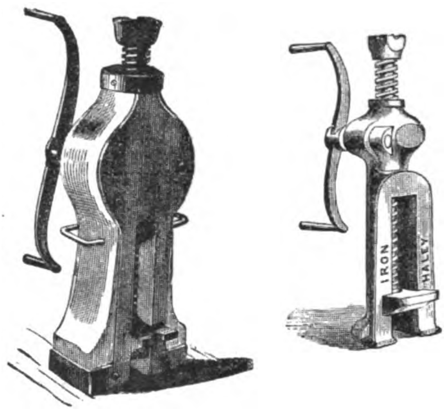
Height when down.		Will Lift.		Prices. £	s.	d.
9 inches	...	1½ tons	...	1	4	0
12 "	...	2 "	...	1	7	6
15 "	...	3 "	...	1	12	0
18 "	...	4 "	...	1	18	6
21 "	...	5 "	...	2	5	0
24 "	...	6 "	...	3	0	0
27 "	...	8 "	...	3	13	0
30 "	...	10 "	...	4	10	0
33 "	...	12 "	...	5	10	0
36 "	...	14 "	..	6	7	6
42 "	...	16 "	...	6	17	6
48 "	...	18 "	...	7	15	0



BOTTLE JACK. No. 6.



HYDRAULIC SHIP JACK.



HALEY'S SCREW JACKS.

HYDRAULIC SHIP JACK.

No.	00	0	1	1A	2	3	4
Will run out . . .	6	7	7	7	7	7	7 in.
Height when down .	12	14	14	14	14	14	14 ,,
Will lift	20	35	50	70	100	150	200 tons.
Price, cast-iron. . .	£9 10*s*.	£12 0*s*.	£15 0*s*.	£16 10*s*.	£18	£22	£26
Price, if with best hammered scrap iron cylinders. .	10 10*s*.	13 10*s*.	16 10*s*.	18 10*s*.	20	24 10*s*.	29

If with safety valve attached, to indicate pressure, £2 extra.

The pump and cistern can be detached from the ram, for working at any distance from the weight to be raised.

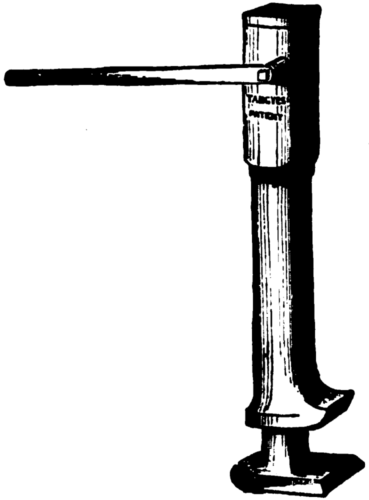
HALEY'S SCREW JACKS.

No.	1	2	3	4	5	6	7	8
Will run out . . .	13	13	13	13	13	14	14	15 in.
Will lift	2	4	6	8	10	12	16	20 tons.
Price, Wood case. .	£4 10*s*.	£5	£5 15*s*.	£7	£8	£9	£12	£17 each.
Do. Iron case . .	Same prices.							

No 68. PATENT HYDRAULIC LIFTING JACK.

To lift	2½	4	6	8	10	12	15	20	30	40	50	60 tons.
Height	18	23	24	25	26	26	26	28	25	28	28	28 inches.
Run out	6	10	10	11	12	12	12	12	12	11	11	10 inches.
Weight	30	57	68	76	86	96	104	132	174	206	264	364 lbs.
Price	£4 0s.	£6 2s. 6d.	£7 12s.	£8 14s.	£10 17s. 6d.	£12	£13 7s. 6d.	£16 5s.	£18 0s.	£20 0s.	£23 10s.	£27 5s. each.

No. 68.



No. 68A.

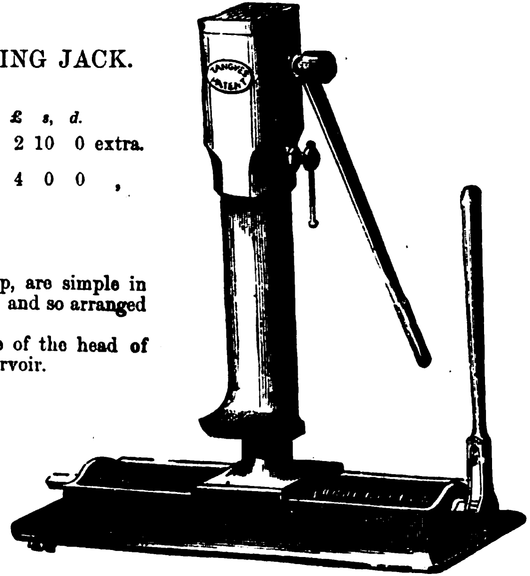
PATENT HYDRAULIC TRAVERSING JACK.

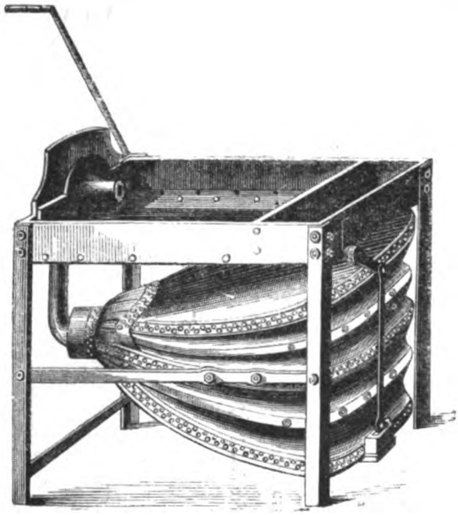
		£	s.	d.	
All sizes from 2½ tons to 12 tons	. . . .	2	10	0	extra.
„ „ 12 „ 20 „	. . . .	4	0	0	„

These Jacks lift either from the foot or top, are simple in action and construction, very safe and portable, and so arranged that one man can lift from 4 to 60 tons.

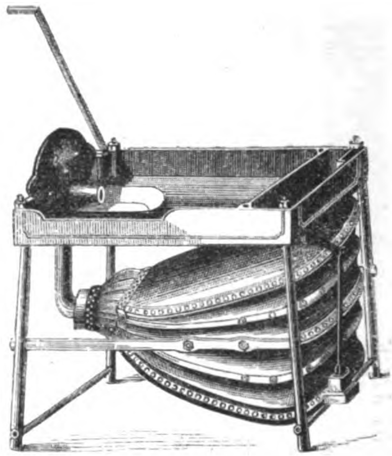
To *lower*, unscrew the stop valve in the side of the head of the Jack, when the fluid will return to the reservoir.

No. 68A.





No. 1.



No. 2.

(No. 1.) BEST WROUGHT-IRON PORTABLE FORGE.

Suitable for ship-builders, engineers, or for any portable use, being light, strong, and not liable to breakage.

Size of Pan . . .	2 ft. 5 in. × 2 ft.	2 ft. 9 in. × 2 ft. 3 in.	2 ft. 10 in. × 2 ft. 6 in.
Bellows	24	26	28 in. wide.
Price	£3 10 0	£4 15 0	£6 0 0 each.
If with Patent CIRCULAR BELLOWS	£4 2 6	£5 7 6	£6 15 0 ,,

(No. 2.) PORTABLE FORGE.

With cast-iron Pan and wrought-iron legs, suitable for Export.

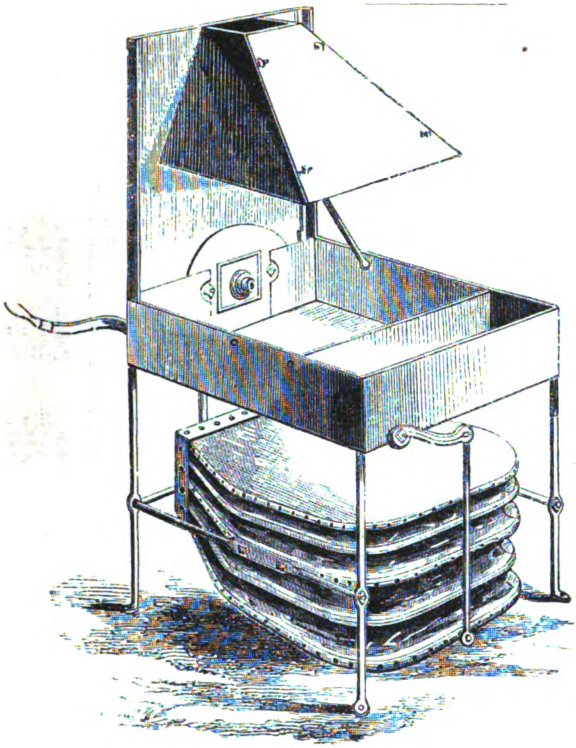
Size of Pan	2 ft. × 1 ft. 6 in.	2 ft. 5 in. × 2 ft.
Bellows	19	24 in. wide.
Price	£3 0 0	£3 10 0 each.
Ditto, if mounted on Wheels .	...	£4 15 0 ,,
Anvil suitable for ditto . . .	£1 7 0	£1 7 0 ,,
If with Vice attached . .	16 0	16 0 ,,

FARRIERS' TOOLS fitted up in deal chests, £2 15 0

(No. 3.) CIRCULAR DECK OR RIVET FORGES.

Size	1 ft. 9 in. diam. × 2 ft. 4 in. high.	2 ft. diam. × 2 ft. 10 in. high.
Bellows	18	22 in. diam.
Single Blast . .	£3 2 6	£4 0 0
Patent double Blast		£5 7 6

Weight for Bellows, 10s. 6*d*. extra.



PORTABLE FORGE WITH HOOD.

PORTABLE FORGE,

ALL OF

WROUGHT-IRON,

WITH BEST

BELLOWS, COMPLETE.

Price with Smoke Hood, complete, as engraved,

No. 1.	No. 2.
18 × 24 in.	24 × 30 in.
£4 7*s.* 6*d.*	£5 10*s.*
No. 3.	No. 4.
25 × 33 in.	27 × 36 in.
£6 17*s.* 6*d.*	£8 10*s.*

For shipment these will pack into a square the size of the pan of Forge.

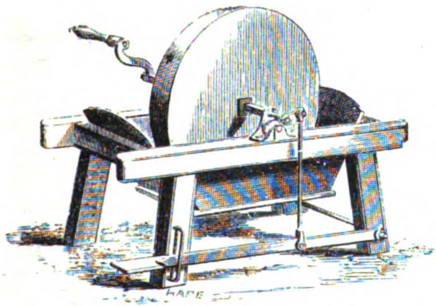


Fig. 1.

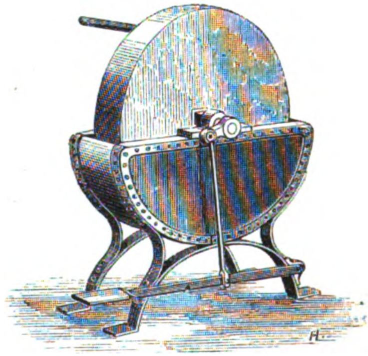


Fig. 2.

GRINDSTONES WITH TROUGHS, FRAMES, HANDLES, AND FOOT TREADLES.

Grindstone in wood trough, as Fig. 1, with spindle mounted on friction roller, £2 10*s.* and £3 each.

Grindstone in wrought-iron trough, with a stone	2 ft.	2 ft. 6 in.	3 ft.	4 ft. diameter.
Price of Fig. 2.	£5	£5 10*s.*	£7 10*s.*	£12 each.

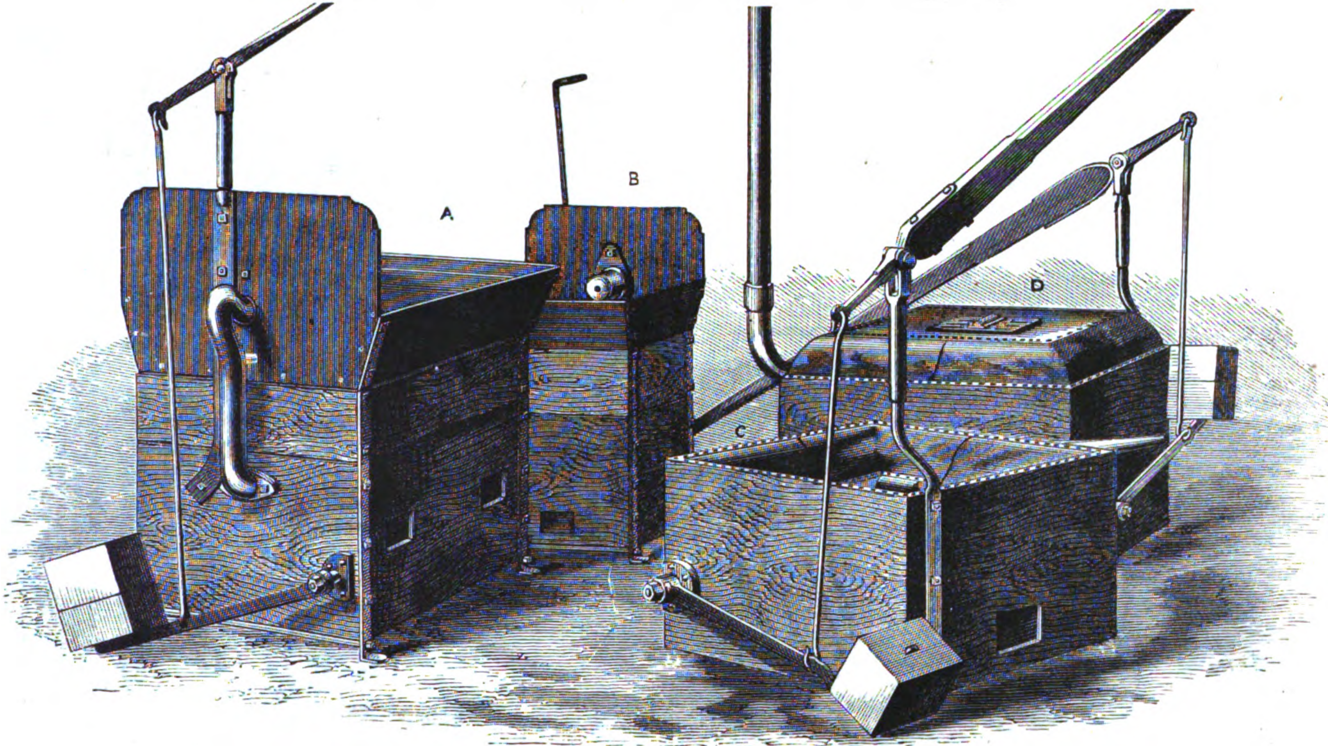
If with turned pulley for steam power, extra 10*s.* to 20*s.*

Packing for export about 10 per cent. on the above prices.

Cast-iron Grindstone trough, for steam power, with shaft, pedestals, and pulley, and with	2 ft.	2 ft. 6 in.	3 ft.	3 ft. 6 in.	4 ft.
Grindstone	£3 7*s.* 6*d.*	£4 15*s.*	£6 15*s.*	£8 10*s.*	£11 10*s.*

Newcastle Grindstones, all sizes.

PATENT PORTABLE FORGES AND FORGE BELLOWS.



PATENT PORTABLE FORGES.

A. Forge with division. B. Rivet Forge No. 0.

	Size of pan.	Height to top of pan.	Weight about.	Price. £ s. d.
No 0.	17×20 in.	26 in.	96 lbs.	3 3 0
„ 1.	22×20 „	28 „	150 „	4 4 0
„ 2.	26×22 „	30 „	180 „	5 0 0
„ 3.	32×26 „	30 „	312 „	7 0 0
„ 4.	36×28 „	32 „	413 „	10 0 0

Nos. 2, 3, and 4, have a division in the pans.

PATENT BELLOWS.

C. Bellows at rest. D. Bellows inflated.

	Size.	Height.	Weight about.	Price. £ s. d.
No. 1.	26×26 in.	15 in.	202 lbs.	4 10 0
„ 2.	29×28 „	17 „	284 „	6 0 0
„ 3.	33×32 „	18 „	330 „	7 0 0
„ 4.	37×36 „	20 „	—	10 0 0

MITCHELL'S SCREW PILES.

THE cost of hollow cast-iron Screw Piles for piers, lighthouses, jetties, moorings, &c., is

				s.	d.	
For piles	10 in. diameter,	7/8 in. thick,	about	8	0	per foot run.
,,	12 ,,	1 ,,		11	3	,,
,,	15 ,,	1 ,,		14	6	,,
,,	18 ,,	1 ,,		18	0	,,

Wrought-iron Screw Piles—

Price per length of	20 feet.		30 feet.		40 feet.	
	£	s.	£	s.	£	s.
4 inches diameter	6	10	8	15	14	0
5 ,, ...	9	15	14	0	21	0
6 ,, ...	16	0	23	0	34	0
7 ,, ...	26	0	42	10	53	0

Cast-iron Piles are usually made in lengths of from 9 to 12 feet, the joints being faced, and the cost is about the same *per ton* whether the diameter is large or small.

But the cost of wrought-iron Piles is materially affected by any increase in diameter, the smaller sizes being rolled, whilst the larger ones must be forged, and the cost of forgings increases very greatly in proportion to the weight.

Wrought-iron Piles can be made in long lengths, and are not liable to breakage in transit; but it is often difficult to obtain vessels with the necessary stowage capacity, and a sufficiently light draught of water, to land the piles where they are required for use.

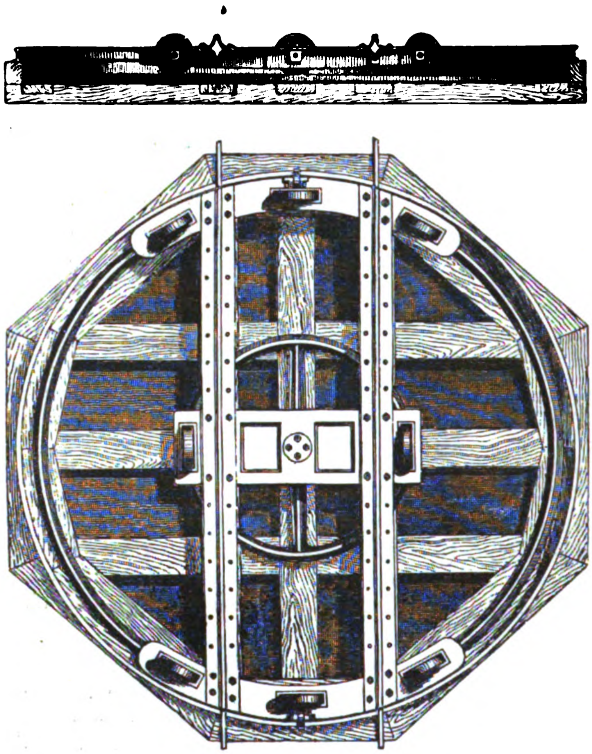
These piles are usually put down by hand in the well-known manner, but the Authors have made Steam Winches somewhat similar in design to those illustrated at p. 29, but modified to suit the special object to be attained, and they are found more rapid and economical than the hand winches usually employed.

THE SUSTAINING POWER OF SCREW PILES.

In compact sand, Screw Piles have been found to carry a load in *tons* equal to six times the square of the diameter of the screw in *feet*. Therefore a pile with a screw 2 ft. 6 in. diameter = 7·854 ft. area × 6 = about 47¼ tons.

WROUGHT-IRON MOORING BUOYS, WITH CHAINS SECURED WITH SCREW PILES,

For mooring vessels up to 2,000 tons with 30 feet of 2¼-inch chain, rings, shackles, &c., about £95, complete, with screw.



RAILWAY TURN-TABLES.

Cast-Iron Turn-Tables—

6 feet 6 in. diameter, each	£26	10s.
8 „ 6 „ „ „	32	0
10 „ 0 „ „ „	42	10
12 „ 0 „ „ „	55	0

Wrought-Iron Turn-Tables (Bridgewater's Patent)—

12 feet diameter, each	£71
13 „ „	80
15 „ „	95
18 „ „	112

Wrought-Iron Turn-Tables (Baines' Patent)—

12 feet diameter, each	£85
18 „ „ „	127

Wrought-Iron Balanced Engine Turn-Tables—

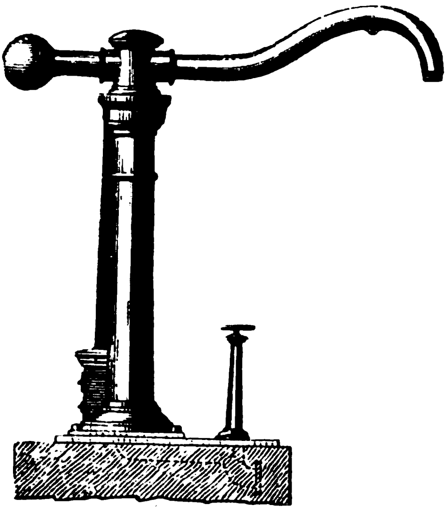
42 feet diameter, each £265

Geared ditto ditto—

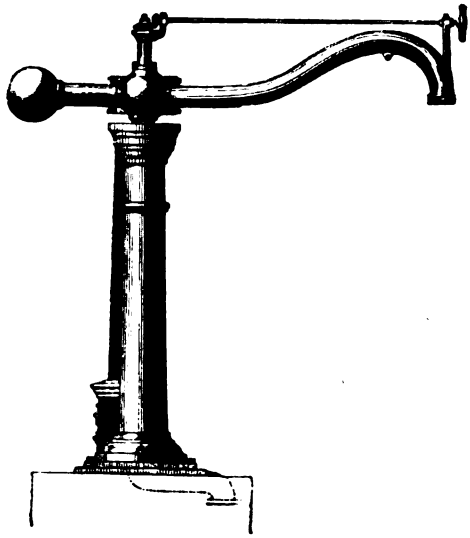
42 feet diameter, each £355

SMALL CHEAP CAST-IRON TURN-TABLES

Are made for Collieries, Tramroads, or for Warehouses, from 3 ft. to 4 ft. 6 diameter, at prices varying from £8 to £15 according to size.



FIXED PILLAR CRANE.



PILLAR CRANE WITH REVOLVING SWAN NECK.

WATER CRANES, OR COLUMNS FOR SUPPLYING LOCOMOTIVES.

With Swan Neck, Fixed Pillar for Leather Hose.	With Revolving Swan Neck.
Price . . . £34 0 0	Price . . . £40 0 0

A Plainer style of Water Crane with revolving arm is made, about . . . £30 0 0

Water Cranes to fix to wall of Engine or Tank House are about £25, see page 111.

Water Tanks for Railway Stations, see pages 111, 184.

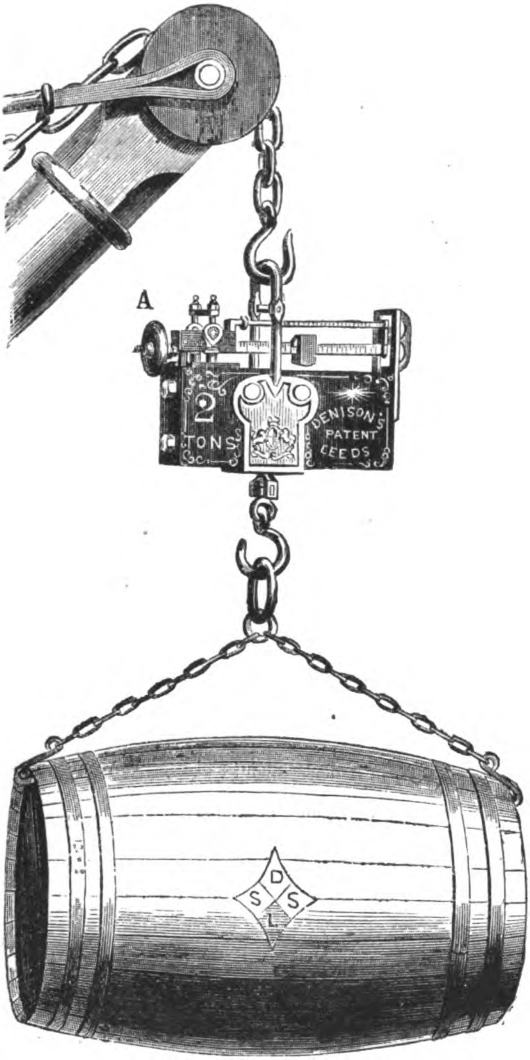
Engines and Pumps for supplying ditto, see pages 109 to 112, 118, &c. &c.

SWITCHES, CROSSINGS, AND SIGNALS FOR RAILWAYS.

Switches and Crossings are made in great variety, according to special requirements in each case, and to suit the particular form and section of rail used on each line of railway; and it is usual for the engineer of the line to specify some particular make or pattern which he considers best for the purpose. Switches will thus vary in price from about £14 per set upwards.

Crossings in like manner vary in price from about £10 each upwards.

Signals, Lever Boxes, &c. vary in the same manner and for the same reasons, and special quotations are usually made for these descriptions of railway plant.



DENISON'S PATENT SUSPENDED WEIGHING MACHINE.

The Machine is portable and is readily applied to any existing crane chain. It is used for weighing goods during their removal from vessels, railway trucks, &c. as well as in factories, warehouses, foundries and other works, and a great saving in time and labour is effected by weighing the goods whilst they are being lifted.

A case, package, or skip, containing loose materials, can be tared off, and the slings or lifting hooks are tared off by means of the ball A.

To weigh.	Price. £	s.	d.
20 Cwt.	7	10	0
25 ,,	8	10	0
30 ,,	10	0	0
40 ,,	12	0	0
50 ,,	14	0	0
8 Tons	16	0	0
4 ,,	19	0	0
5 ,,	22	0	0
10 ,,	27	0	0
20 ,,	36	0	0
26 ,,	40	0	0
30 ,,	50	0	0
40 ,,	60	0	0

WEIGHING MACHINES.

No. 1. SALTER'S PATENT CIRCULAR SPRING BALANCE, for railway platforms,

To weigh by Half-pounds.

	200 lbs.	224 lbs.	250 lbs.	300 lbs.	336 lbs.
Diameter of plate	14	14	16	18	18 inches.
Price, with hook only	37/6	44/0	50/0	63/0	70/0 each.

To weigh by Oe Pound.

	400 lbs.	450 lbs.	500 lbs.	560 lbs.	600 lbs.
Diameter of plate	14	14	16	16	18 inches.
Price, with hook only	44/0	50/0	57/0	60/0	63/0 each.

IRON BRACKET to fix to a wall, with levers and rod for Balance. To carry 3 cwt. price 35*s.*; to carry 3 to 6 cwt. price 42*s.* 6*d.*

SCALE with Double Iron Arms and Iron Bottom for luggage, &c. To carry 3 cwt. price 26*s.* 6*d.*; to carry 3 to 6 cwt. price 37*s.*

No. 2. SALTER'S PATENT PLATFORM WEIGHING MACHINE to weigh 3 cwt. by 1 lb. with 24 × 20 in. scale. Price, With back, 92*s.*; Without back, 83*s.*

DITTO to weigh 5 cwt. by 1 lb. with 28 × 24 in. scale. Price, With back, 125*s.*; Without back, 115*s.* If fitted with wheels, 7*s.* 6*d.* extra.

No. 3. SALTER'S PATENT DYNAMOMETER for testing the draught of ploughs, carriages, &c. to indicate up to 10 cwt. Price 38*s.* including box. 2*s.* 6*d.* extra for each cwt. above 10 cwt

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No. 871.—BEST PATENT STEELYARDS.

To weigh	60	100	160	224	350	450	600 cwt.
With Iron Ball, per pair	10*s.* 6*d.*	13*s.*	17*s.*	21*s.*	31*s.* 6*d.*	52*s.*	80*s.*

Intermediate sizes are made.

LARGE STEELYARDS.

To weigh	10	15	20	30	40	50 cwt.
Per pair	63*s.*	82*s.*	94*s.*	113*s.*	132*s.*	140*s.*

Larger sizes at 50*s.* per ton.

No. 111.—PORTABLE PLATFORM MACHINE for weighing Sacks of Flour, Corn, &c. on Two wheels.

To weigh	3	4	5 cwt.
Price each	70*s.*	80*s.*	95*s.*

No. 112.—PLATFORM WEIGHING MACHINE, mounted on 4 Wheels.

To weigh	3	5	7	10	15	20 cwt.
Price, each	£3 10*s.*	£5	£6	£6 10*s.*	£9 5*s.*	£12 15*s.*

CART WEIGHING MACHINES.

To weigh	3 tons,	platform	6 ft. × 4 ft. 6 in.	£25.
Ditto	5 ,,	,,	6 ft. × 6 ft.	£32.
Ditto	5 ,,	,,	12 ft. × 6 ft.	£40.

Working Plans of instructions for erection are sent out with each machine, or, if required, a competent man is sent to erect, at an extra charge.

MACHINE TOOLS, &c.

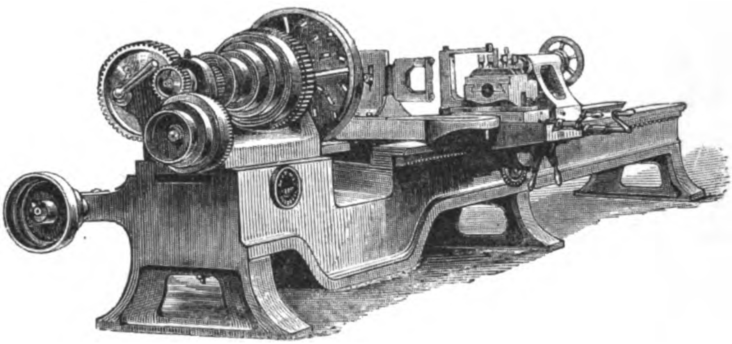
FOR

ENGINEERS, CONTRACTORS,

LOCOMOTIVE

AND

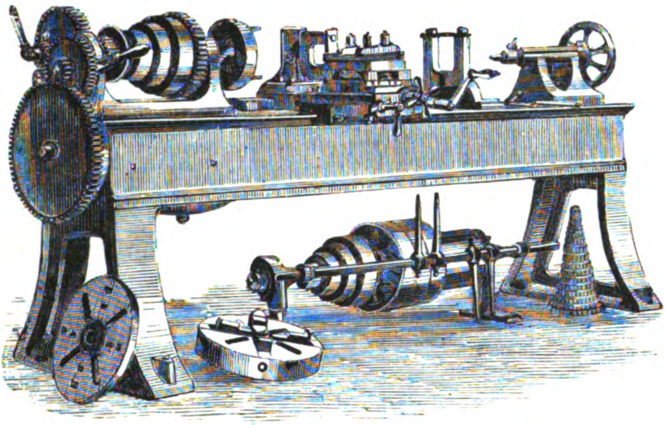
RAILWAY CARRIAGE WORKS.



SLIDE LATHES.

THE Beds are accurately planed and finished, and the motions are self-acting longitudinally and transversely. The Nos. 9 and 10 are treble geared, and the Nos. 2 to 8 are double geared; all are provided with compound slide rest, two face plates, one tool rest, one steady rest, overhead motion, and screw keys.

No.	Height of Head-stock.	Length of Bed.	Between Centres.		Will take in Diam.		Price.			Extra per foot of Bed.			Extra for Gap in Bed.			Approximate weight.
	Inches	Feet.	Ft.	In.	Ft.	In.	£	s.	d.	£	s.	d.	£	s.	d.	Cwt.
1	7	8	4	6	0	9	48	0	0	2	2	0	4	5	0	12
2	6	6	3	0	0	7	48	0	0	1	12	0	3	4	0	12
3	7	8	4	6	0	9	58	0	0	2	2	0	4	5	0	20
4	8	10	6	4	0	11	74	0	0	2	8	0	6	8	0	30
5	9	12	8	0	1	0	90	0	0	2	13	0	7	10	0	36
6	10	12	7	9	1	2	100	0	0	3	4	0	8	10	0	42
7	12	14	8	9	1	5	128	0	0	3	15	0	10	15	0	75
8	15	14	7	9	1	10	148	0	0	4	5	0	12	15	0	112
9	18	18	10	9	2	2	233	0	0	5	6	0	16	0	0	100
10	21	18	10	6	2	8	275	0	0	6	10	0	21	10	0	170



SLIDE AND SCREW CUTTING LATHES.

The beds are of iron, accurately planed and got up, and are carried on strong iron standards, the headstocks are double geared and fitted with case-hardened spindles and conical bushes, compound slide rest, apparatus for screw cutting, self-acting sliding and surfacing motions, guide screw, and change wheels. Each Lathe is supplied with two face plates, one steady rest and following stay, overhead motion, hangers and forked guides for strap, screw keys, &c. complete.

No.	Height of Head-stock.	Length of Bed.	Between Centres.	Diam. over Carriage.	Price.	Extra for each additional foot of Bed.	Extra with Gap.	Approximate weight.
	Inches.	Feet.	Ft. In.	Ft. In.	£ s. d.	£ s. d.	£ s. d.	Cwt.
1	6	4	1 0		45 0 0			11
2	6	6	3 0	0 7	53 0 0	2 15 0	3 5 0	13
3	7	8	4 6	0 9	64 0 0	3 0 0	4 5 0	20
4	8	10	6 4	0 11	80 0 0	3 5 0	6 10 0	35
5	10	12	7 9	1 2	106 0 0	3 15 0	8 10 0	44
6	12	14	8 9	1 5	150 0 0	4 5 0	10 10 0	75
7	15	14	7 9	1 10	170 0 0	4 15 0	12 15 0	112

STUD OR BOLT TURNING LATHES.

Single Stud, or Bolt Turning **Lathe,** with dead centres, bed 3 feet long, overhead motion, **and screw keys** **£40**

Double Stud, or Bolt Turning Lathe, with two poppit heads, dead centres, **bed 5 feet long, overhead motion, and screw keys** **£48**

RAILWAY WHEEL LATHES.

Will turn a pair of railway wheels on their own axle at the same time, and without torsion to the axle. This Lathe will also bore two tyres at the same time. The two compound slide-rests are self-acting in all directions; and each force-plate may be used for different purposes, such as boring wheels, &c. It is fitted with self-acting boring motion and boring bar, overhead motion, and screw keys.

No.	Diameter of Face Plate.	Price.	Approximate Weight.
	ft. in.	£ s. d.	
1	3 6	295 0 0	210 cwt.
2	4 0	300 0 0	220 „
3	4 0	350 0 0	280 „
4	5 0	400 0 0	360 „
5	6 0	465 0 0	448 „
6	7 0	530 0 0	490 „

SURFACE LATHES,

On strong planed foundation-plates, and fitted with treble gear, self-acting compound slide-rest, overhead motion, and screw keys.

	£	s.	d.
No. 1, with head 3 feet high	150	0	0
„ 2, „ 4 „	173	0	0
„ 3, „ 5 „	233	0	0
„ 4, „ 6 „	320	0	0
„ 5, „ 8 „	425	0	0
„ 6, „ 12 „	635	0	0

BELL CHUCKS.

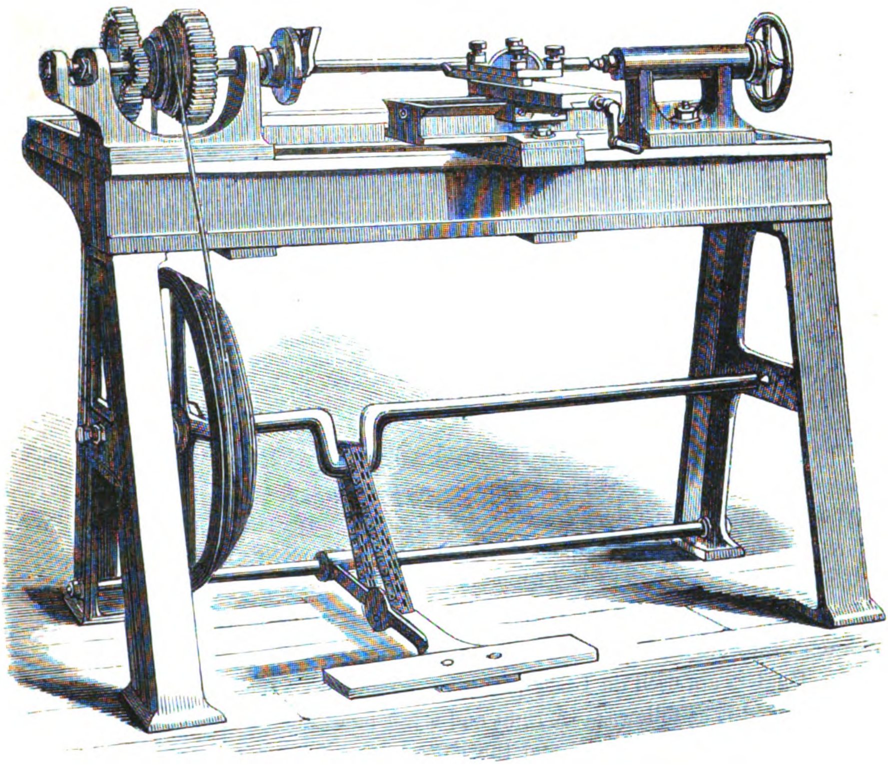
Each Chuck has 8 case-hardened jaws.

Diameter:	6	7	8	10	12	15	18 in.
Price . .	£3 15*s.* 0*d.*	£4 5*s.* 0*d.*	£4 17*s.* 6*d.*	£5 7*s.* 6*d.*	£5 15*s.* 0*d.*	£6 7*s.* 6*d.*	£7 0*s.* 0*d.*

JAWED CHUCKS.

With case-hardened jaws, screws, and pinions.

Diameter:	12	14	16	18	20	24	30 in.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Price, with 3 jaws connected by gearing.	7 10 0	8 10 0	9 10 0	11 12 6	12 15 0	16 0 0	19 0 0
Price, with 4 jaws unconnected . .	6 7 6	7 10 0	8 10 0	9 10 0	10 10 0	12 15 0	16 0 0



No. 1 BACKGEARED FOOT-LATHE.

HAND AND FOOT LATHES.

No. 1.

Strong Engineer's Foot Lathe (as drawing) with double-geared headstocks, planed cast-iron bed and standards, 2 face-plates, socket and T rest;—overhead motion consisting of 2 hangers, cone pulley, and shaft, Compound Slide Rest, &c. complete.

			£	s.	d.		£	s.	d.
6 in. centre,	5 ft.	Iron Bed	29	0	0	Extra Length of Iron Bed, per foot	1	1	0
7 in. ,,	6 ft.	,,	34	0	0	,, ,, ,,	1	4	0
8 in. ,,	8 ft.	,,	43	0	0	,, ,, ,,	1	7	6
10 in. ,,	10 ft.	,,	63	0	0	,, ,, ,,	1	11	0

No. 2.

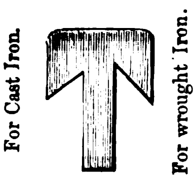
Strong Engineer's Lathe, with planed cast-iron bed and standards, 2 face-plates, socket and T rest, top-speed pulley to match the one on fly-wheel, chucks, crank, treadle, &c. complete.

			£	s.	d.		£	s.	d.
6 in. centre,	4 ft.	Iron Bed	13	13	0	Extra Length of Iron Bed, per foot	1	1	0
7 in. ,,	6 ft.	,,	19	0	0	,, ,, ,,	1	4	0
8 in. ,,	6 ft.	,,	22	10	0	,, ,, ,,	1	7	6

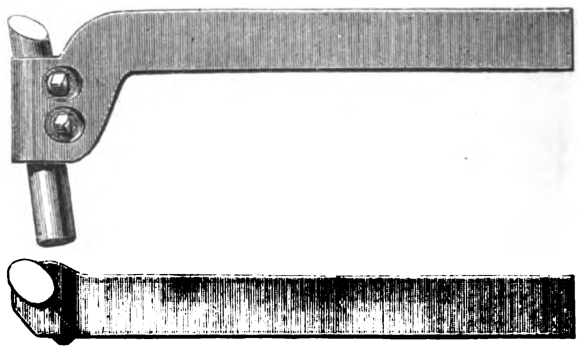
No. 3.

Lathe with iron bed, solid collar-head, rest and tee, centre-head, fly-wheel and pulley for strap, centre-chuck, drill-chuck, worm-chuck, fork-chuck, crank and treadle complete.

3½ in centre	2 ft. 6 in. Iron Bed	Price	£6	0	0
4 ,, ...	3 ft. 0 in. ,, ...	,,	8	0	0
5 ,, ...	3 ft. 9 in. ,, ...	,,	9	10	0
6 ,, ...	5 ft. 0 in. ,, ...	,,	12	10	0



ANGLE GAUGE.



SMITH'S PATENT TOOL-HOLDERS.

The Cutters are made of round cast steel and they are ground on the stone to the gauge which gives the correct angle for wrought or cast metals.

By this means the Cutters are brought to one uniform shape and the ground surface is reduced to a minimum, whilst the work is so simple that it can be done by a labourer.

For moderately heavy work the Holders are made with one set screw, but for large tools they are made, as shown, with two set screws.

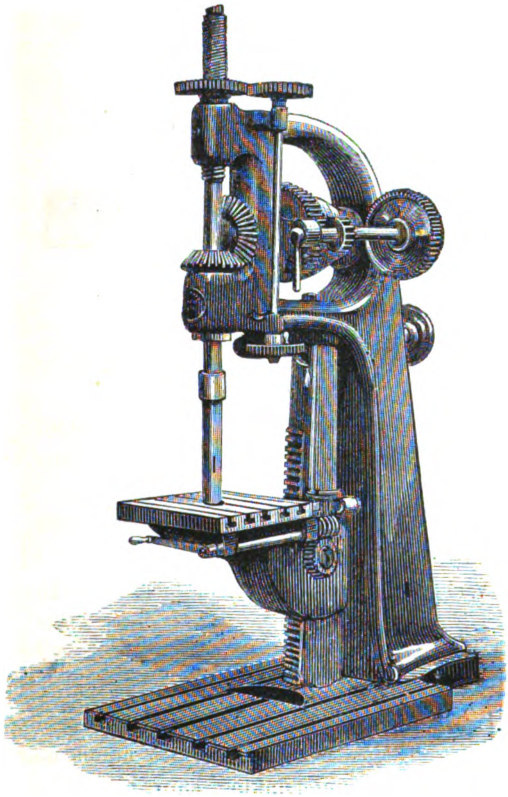
These Holders are used on Lathes, Planing, Shaping and Slotting Machines; the system adopted is as follows:—A right and a left hand holder with 12 steel cutters are provided for each machine, and the cutters are arranged in a small box, the cutting edge being upwards; as they become blunt, the workman returns them to the box but with the blunted end downwards; the labourer who grinds them sees at a glance which require to be reground, and he collects and returns them without the necessity of the workman leaving the Machine.

The prices of the Tool-holders, *per pair* (including a Box-key), and of Cutters, are as follows:

Diam. of Steel.	Suitable for use in Lathes.	Suitable for use in Shaping Machines.	Maximum depth of cut.	Tool-holders per pair. £	s.	d.	Cutters per dozen. £	s.	d.
5/16 in.	up to 6 in. centres	up to 5 in. stroke.	1/8 in.	1	8	6	0	4	0
3/8 ,,	,, 8 ,,	,, 7 ,,	3/16 ,,	1	12	6	0	4	6
1/2 ,,	,, 10 ,,	,, 10 ,,	1/4 ,,	1	17	6	0	7	6
5/8 ,,	,, 12 ,,	,, 13 ,,	5/16 ,,	2	2	6	0	11	0
7/8 ,,	,, 15 ,,	,, 16 ,,	7/16 ,,	2	16	6	0	18	0
With two set screws for holding the Cutter.									
7/8 ,,	,, 15 ,,	,, 16 ,,	7/16 ,,	3	10	0	0	18	0
1 1/4 ,,	,, 18 ,,	,, 20 ,,	5/8 ,,	5	15	0	2	14	0
1 3/4 ,,	,, 24 ,,	,, 24 ,,	7/8 ,,	9	10	0	7	4	0

Angle Gauges, 4s. each.

GEARED DRILLING AND BORING MACHINES.



No. 1. With Table to rise and fall on angular slides by rack and pinion; the Spindle is 2 inches in diameter, and is 15 inches from the front of frame to centre of spindle, self-acting feed 8 inches range. Complete with one boring bar, driving apparatus, and Screw Keys, weight about 26 cwt. *Price* £53 0*s.* 0*d.*

No. 2. With Table to rise and fall on a round pillar, by worm and wheel and rack and pinion; the Spindle is 2¼ inches diameter, and is 15 inches from the front of pillar to centre of spindle, with self-acting feed motion 12 inches range, and will bore up to 7 inches diameter. Complete with driving apparatus and Screw Keys, weight about 24 cwt. . . *Price* £58 0*s.* 0*d.*

No. 3. With Table to rise and fall on round pillar, 10 inches diameter, by worm and wheel and rack and pinion, with Spindle 2⅜ inches diameter, and 18 inches from the front of pillar to centre, self-acting feed motion 15 inches range. Complete with driving apparatus and Screw Keys, weight about 27 cwt. *Price* £64 0*s.* 0*d.*

No. 4. With Table to work as No. 3, on pillar 12 inches diameter; the Spindle is 2⅜ inches diameter, and is 26 inches from front of pillar to centre of Spindle, with self-acting feed motion 18 inches range, and will bore up to 16 inches diameter. This Machine is fitted with two boring bars and bushes, two drill chucks, and the table is made to turn out of the way to enable large work to be fixed on the base plate. Complete with driving apparatus and Screw Keys, weight about 55 cwt.. . . . . *Price* £90 10*s.* 0*d.*

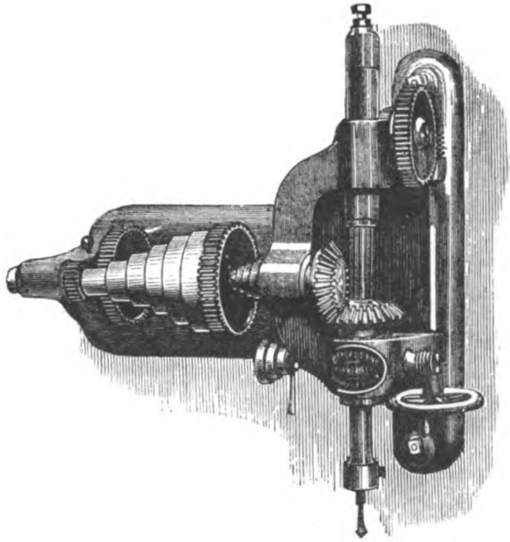
No. 5. With Table to work as No. 3, on pillar 20 inches diameter, with bolt holes in the base plate for fixing large work; the Spindle is 4 inches diameter, and is 30 inches from front of pillar to centre of Spindle, with self-acting feed motion 30 inches range, and will bore up to 24 inches diameter. This Machine is fitted with two boring bars and bushes, two drill chucks, and the table is made to turn out of the way to enable large work to be fixed on the base plate. Complete with driving apparatus and Screw Keys, weight about 152 cwt. . *Price* £190 0*s.* 0*d.*

UNGEARED AND PORTABLE DRILLING MACHINES.

No. 1. Single power Machine to fix on a bench or stand, with Spindle 1¼ inches in diameter, 9 inches to centre, 4 inches range to feed by foot and circular table, to rise and fall by hand. Complete with driving apparatus and Screw Key, weight about 4 cwt. . . . . *Price* £8 10*s.* 0*d.*

No. 2 is similar to that described above, but with hand feed motion, and is stronger and more powerful . . . . *Price* £15 0*s.* 0*d.*

No. 3. With Table to rise and fall on angular slides by rack and pinion; the Spindle is 1⅜ inches diameter, and is 13 inches from front of Machine to centre of Spindle, with self-acting feed motion 6 inches range, and will drill 1½ inches diameter. Complete with driving apparatus and Screw Key, weight about 12 cwt. . . . . *Price* £39 0*s.* 0*d.*



WALL-DRILLING MACHINES.

No. 1 is 13 inches from wall to centre, spindle $1\frac{3}{4}$ inches diameter, hand feed adapted for moderately light work. Weight about 6 cwt . . . *Price* £14 15*s*.

No. 2 is 22 inches from wall to centre, spindle $1\frac{1}{2}$ inches diameter, self-acting feed with a range of 6 inches, driving apparatus and screw keys. Weight about 5 cwt. . . . . *Price* £16 17*s*. 6*d*.

No. 3 is 30 inches to centre, spindle $2\frac{1}{4}$ inches diameter, with a range of 4 inches, and hand-lever feed, adapted for countersinking ship plates, &c. Weight about 11 cwt . . . . *Price* £22 10*s*.

No. 4. Geared Machine, 24 inches to centre, spindle $2\frac{1}{4}$ inches diameter, self-acting feed with a range of 12 inches, top-driving apparatus and screw keys. Weight about 15 cwt . . . . *Price* £40.

No. 5. Geared Machine 45 inches to centre, spindle $2\frac{1}{2}$ inches diameter, self-acting feed with a range of 24 inches, iron bed 12 feet long, and one transverse slide, one boring bar and bush, one drill chuck, driving apparatus and screw keys; will bore up to 18 inches diameter. Weight about 65 cwt. . . . . *Price* £128

No. 6. Geared Machine, 48 inches from wall to centre, spindle 4 inches diameter, self-acting feed with a range of 30 inches, iron bed 20 feet long, and two transverse slides, two boring bars and bushes, two drill chucks; will bore up to 24 inches diameter. Weight about 6 tons . . . . *Price* £170.

RADIAL DRILLING MACHINES.

No 1. Geared Machine. The radial arm works on a strong pillar fixed to the floor; it moves through the whole circle and can be raised or lowered 24 inches. It has a self-acting feed motion with a range of 12 inches; the spindle can be worked at any radius between 2 feet 3 inches and 5 feet 6 inches, and the Machine will take in an object 5 feet high from the floor. Complete, with portable table, overhead motion and screw keys. Weight about 75 cwt. Price £140.

No 2. Geared Machine. The radial arm is fixed to a massive pillar, and moves through an arc of 200 degrees, and can be raised or lowered 26 inches; the Machine will take in an object 6 feet high from the floor. It has a self-acting feed with a range of 14 inches, and the spindle will work at any radius between 2 feet 6 inches and 7 feet. Complete, with portable table for fixing small work, overhead motion and screw keys. Weight about 125 cwt. Price £200.

No 3. Three Radial Arms are fixed on a table 24 feet long and 2 feet 6 inches wide. These arms do not rise and fall, but they are arranged to bore a hole on any part of the table. The spindles are 2¼ inches diameter, double-geared, with self-acting feed of 12 inches range, and any spindle can be stopped independently of the others. Complete, with overhead motion and screw keys.
Weight about 170 cwt. Price £265.

BORING MILLS.

Portable framed Mill, 5 feet 6 inches wide, inside frame with boring bar 6 inches diameter, driven by worm and wheel with conical speed pulleys; will bore 5 feet long and 30 inches diameter. Complete, with 1 cutter block, 3 radial jaws for fixing cylinders, overhead motion and screw keys.
Weight about 90 cwt. Price £135.

KEY BED DRILLING AND GROOVING MACHINES.

No 1. Single Power, with table 2 feet long and 6 inches traverse; will cut a key-way up to 1 inch wide and 4 inches deep. Complete, with overhead motion and screw keys. Weight about 22 cwt. Price £65.

No 2. Double Geared, with table 4 feet long and 12 inches traverse; will slot 3 inches wide and 9 inches deep. Complete, with overhead motion and screw keys. Weight about 38 cwt. Price £100.

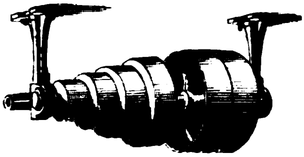
No 3. Axle Grooving Machine, with self-acting traverse motion; will take in 7 feet 6 inches, and groove both ends of a railway axle at once. Complete, with overhead motion and screw keys. Weight about 40 cwt. Price £100.

WHEEL CUTTING AND DIVIDING MACHINES.

No 1. Will Cut Wheels up to 2 feet diameter and 6 inches broad; is fitted with 52 change wheels, face plate, headstocks and spindles for metal or wood, 1 arbor, 1 cutter for metal, 1 cutter for wood, brass table of change wheels; overhead motion and screw keys. Weight about 20 cwt. Price £70.

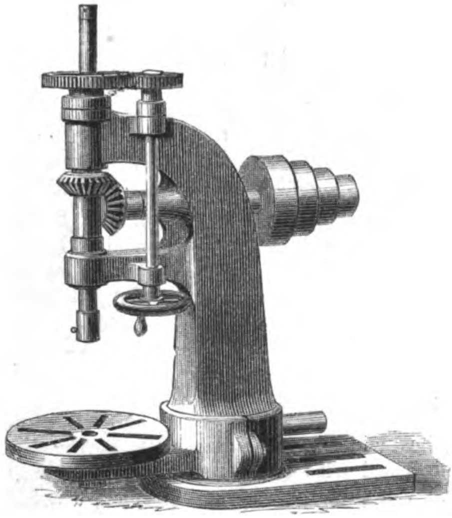
No 2. Fitted as No. 1. but proportioned to cut wheels up to 4 feet diameter and 10 inches broad. Weight about 55 cwt. Price £112.

No 3 Fitted as No 1. but proportioned to cut wheels up to 8 feet diameter and 12 inches wide. Weight about 90 cwt. Price £155.



SMALL BENCH DRILLING MACHINE,

FOR STEAM POWER,



With cone speed pullies, overhead motion, and hand screw feed; the drill table is moveable, and may be fixed either horizontally, as shown in the Engraving, or by turning the holder round the table is placed in a vertical position on the pin seen at the back of machine, or it will turn out of the way altogether when any *long article* has to be operated upon. Will drill up to $1\frac{1}{2}$ in. diameter, and 10 in. to centre of spindle.

Price £15 10s.

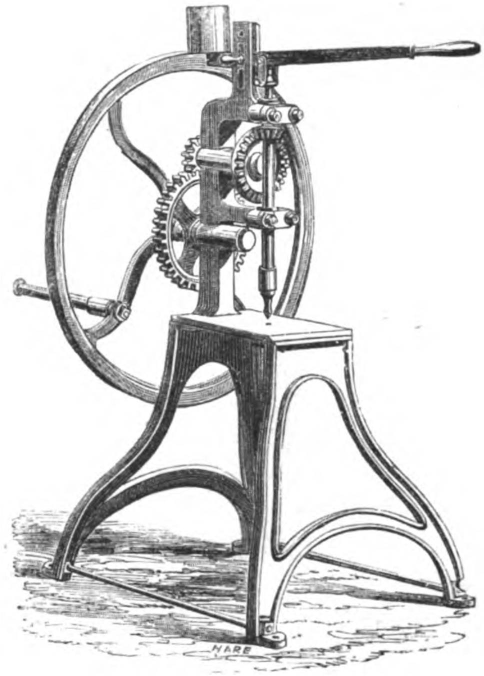
CAST STEEL TWIST DRILLS AND SOCKETS.

TURNED DRILLS, WITH TAPER SHANKS.					STRAIGHT SHANKS.			
Diameter of Drills.	Entire Length of Drills.	Length of Twist.	Price per Drill.	No. & Price of Sockets for Drills.	Diameter of Drills.	Entire Length of Drills.	Length of Twist.	Price per Drill.
INCH.	INCH.	INCH.	s. d.		INCH.	INCH.	INCH.	s. d.
$\frac{3}{8}$	$7\frac{1}{8}$	$3\frac{9}{16}$	2 3	No. 1, 4s.	$\frac{1}{16}$	$1\frac{3}{4}$	$\frac{13}{16}$	0 5
$\frac{13}{32}$	$7\frac{5}{16}$	$3\frac{11}{16}$	2 5		$\frac{3}{32}$	2	$1\frac{1}{8}$	0 6
$\frac{7}{16}$	$7\frac{1}{2}$	$3\frac{3}{4}$	2 7		$\frac{1}{8}$	3	$1\frac{3}{4}$	0 6
$\frac{15}{32}$	$7\frac{11}{16}$	$3\frac{13}{16}$	2 9		$\frac{5}{32}$	$3\frac{1}{2}$	$1\frac{7}{8}$	0 7
$\frac{1}{2}$	$8\frac{9}{16}$	$3\frac{7}{8}$	3 0	No. 2 Socket, 5s.	$\frac{3}{16}$	$3\frac{3}{4}$	$2\frac{1}{8}$	0 8
$\frac{17}{32}$	$8\frac{11}{16}$	$4\frac{1}{8}$	3 2		$\frac{7}{32}$	4	$2\frac{1}{4}$	0 9
$\frac{9}{16}$	9	$4\frac{5}{16}$	3 4		$\frac{1}{4}$	$4\frac{1}{4}$	$2\frac{1}{2}$	0 11
$\frac{19}{32}$	$9\frac{3}{16}$	$4\frac{1}{2}$	3 8		$\frac{9}{32}$	$4\frac{1}{2}$	$2\frac{5}{8}$	1 1
$\frac{5}{8}$	$9\frac{3}{8}$	$4\frac{11}{16}$	4 1		$\frac{5}{16}$	$4\frac{3}{4}$	$2\frac{3}{4}$	1 4
$\frac{21}{32}$	$9\frac{9}{16}$	$4\frac{7}{8}$	4 6		$\frac{11}{32}$	5	$2\frac{7}{8}$	1 7
$\frac{11}{16}$	$9\frac{3}{4}$	5	4 11	No. 3 Socket, 6s.	$\frac{3}{8}$	$5\frac{1}{4}$	3	1 11
$\frac{3}{4}$	$10\frac{1}{2}$	$5\frac{1}{4}$	6 0		$\frac{13}{32}$	$5\frac{1}{2}$	$3\frac{1}{8}$	2 1
$\frac{13}{16}$	$10\frac{11}{16}$	$5\frac{5}{8}$	7 0		$\frac{7}{16}$	6	$3\frac{1}{4}$	2 3
$\frac{7}{8}$	$11\frac{3}{8}$	$6\frac{3}{16}$	8 2		$\frac{1}{2}$	$6\frac{1}{2}$	$3\frac{5}{8}$	2 8
$\frac{15}{16}$	$11\frac{7}{8}$	$6\frac{11}{16}$	9 3	No. 4 Socket, 7s 6d.	$\frac{9}{16}$	$7\frac{1}{8}$	$4\frac{2}{3}$	3 0
1	$12\frac{1}{4}$	,,	10 5		$\frac{5}{8}$	$7\frac{3}{4}$	5	3 9
$1\frac{1}{16}$	,,	,,	11 6		$\frac{11}{16}$	$8\frac{1}{4}$	$5\frac{3}{8}$	4 6
$1\frac{1}{8}$	,,	,,	12 7		$\frac{3}{4}$	$8\frac{3}{4}$	$5\frac{3}{4}$	5 7
$1\frac{3}{16}$	,,	,,	13 9					
$1\frac{1}{4}$	,,	,,	14 10					

In sharpening, care should be taken to maintain the same angle of cutting edge as that with which they were originally finished.

PORTABLE HAND-POWER DRILLING MACHINE,

COMPLETE WITH STAND.



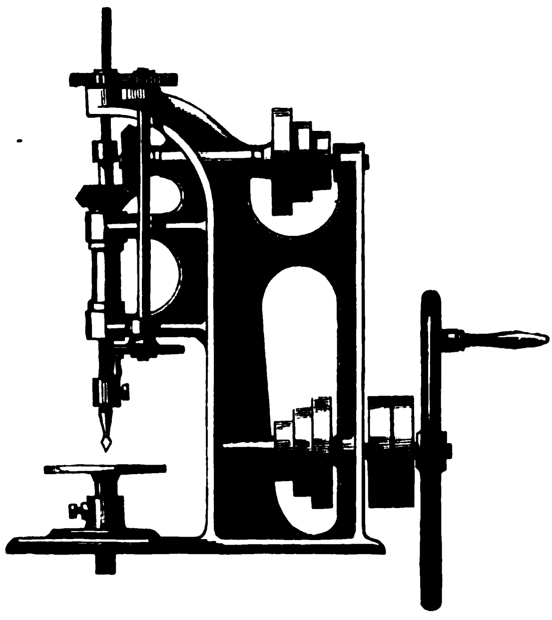
Is extremely simple, strong, and easily driven by a boy; will drill holes up to 1½ inches diameter. The pressure is applied in front by a Lever, as shewn, and may be lifted instantly out of work.

Price £7 5*s.* 0*d.* Ditto, without Standards, to bolt to a Table or Work Bench, £6 5*s.* 0*d.* If with Bright Bed Plate extra, 17*s.* Boring Bar and Knife extra.

Wheel and Screw Feed, instead of Hand Lever, 30*s.* extra.

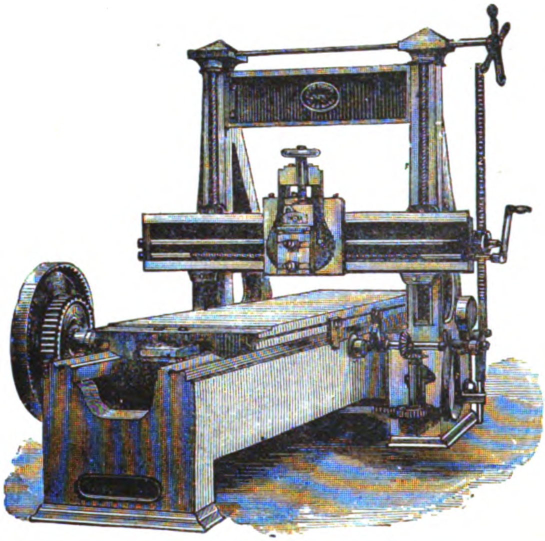
IMPROVED BENCH-DRILLING MACHINE,

FOR HAND OR STEAM POWER,



Fitted with Cone Speed Pulleys, Screw Feed, Fast and Loose Pulley, Fly-wheel for hand-power, and with moveable Table; will drill holes up to 1 inch diameter.

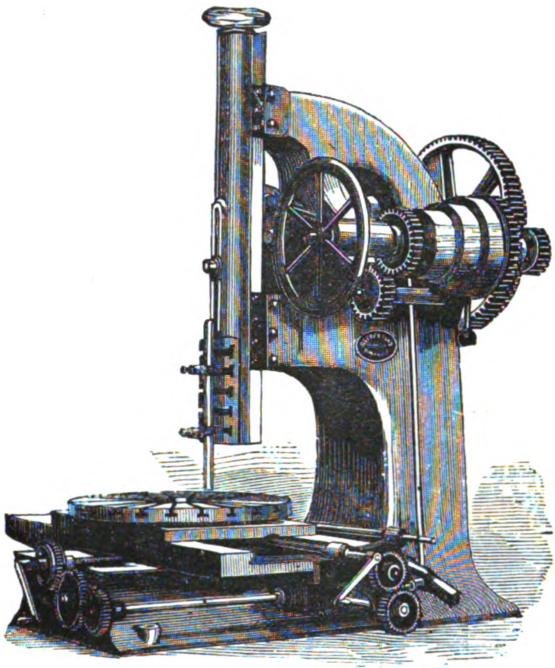
Price, £17.



PLANING MACHINES.

All these Machines are self-acting in the horizontal, vertical, and angular cuts, and have quick return motions.

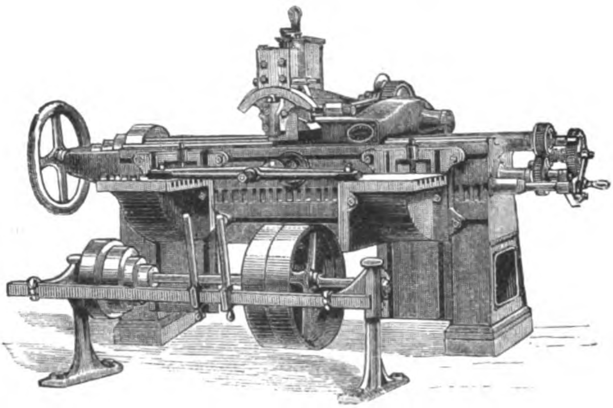
No.	Will take in Length.		Breadth.		Height.		Price.			Extra length of Table per foot.			Extra Tool Boxes each.			Approximate weight.
	Ft.	In.	Ft.	In.	Ft.	In.	£	s.	d.	£	s.	d.	£	s.	d.	Cwt.
1	3	0	1	6	1	6	80	0	0	4	5	0	—			30
2	4	0	2	0	1	6	95	0	0	4	15	0	—			35
3	6	0	2	0	2	0	116	0	0	5	5	0	—			40
4	6	0	2	6	2	6	138	0	0	5	17	6	—			55
5	8	0	3	0	3	0	170	0	0	6	7	6	—			116
6	10	0	3	6	3	6	205	0	0	7	10	0	37	0	0	125
7	12	0	4	0	4	0	263	0	0	8	10	0	37	0	0	180
8	12	0	4	6	4	6	305	0	0	9	10	0	42	0	0	200
9	14	0	5	6	5	6	375	0	0	10	15	0	42	0	0	310



SLOTTING MACHINES.

These Machines are fitted with self-acting compound slides, revolving table, and a variable stroke. All are geared in proportion to the work for which they are adapted, and the larger sizes have quick return motions.

Number.	*Maximum stroke.*		*Longitudinal Traverse.*		*Transverse Traverse.*		*Diameter of Table.*		*Will take in Diam.*		*Price.*			*Approximate weight.*
	ft.	in.	ft.	in	ft.	in.	ft.	in.	ft.	in.	£	s.	d.	Cwt.
1	0	6	0	6	0	9	1	4	1	6	48	0	0	20
2	0	6	1	0	1	0	1	6	4	0	50	0	0	21
3	0	9	1	4	1	0	1	6	2	0	64	0	0	28
4	0	11	1	6	1	2	1	11	3	0	100	0	0	45
5	1	2	2	0	1	4	2	9	4	0	127	0	0	80
6	1	4	2	6	1	6	3	3	5	0	180	0	0	115
7	1	8	4	6	2	6	4	4	7	0	350	0	0	220



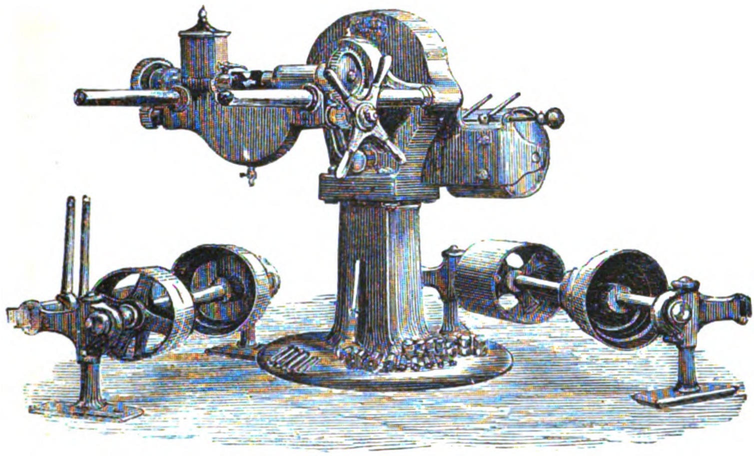
SHAPING MACHINES.

Self-acting and with a variable stroke for curved, angular, or plain surfaces. All Machines are supplied with an expanding conical mandril, overhead motion, screw keys, and water can; and those above 6-inch stroke have a quick return motion. The Machines Nos. 1 and 2 are for plain work only. The No. 3 is fitted with 1 tool-head, 1 table, and 1 vice; the Nos. 4 and 5 have 1 tool-head, 2 tables, and 1 vice.

No.	Length of Bed.		Length Planed		Maximum Stroke.	Diam. of Circular Work.	Price.			Approximate weight.
	ft.	in.	ft.	in.	inches.	inches.	£.	s.	d.	Cwt.
1	2	6	1	6	8	...	53	0	0	...
2	4	0	2	0	20	...	70	0	0	...
3	3	0	1	9	6	8	70	0	0	...
4	4	6	3	0	10	10	95	0	0	31
5	6	0	4	0	13	12	116	0	0	50

COMPOUND SLIDE RESTS.

Height of Lathe Head.	Longitudinal Traverse.	Cross Traverse	Price.		
Inches.	Inches.	Inches.	£	s.	d.
6	10	6	6	10	0
7	12	7	7	10	0
8	15	8	9	10	0
10	18	10	12	12	0
12	21	11	16	0	0
15	24	12	19	0	0
18	27	12	22	10	0
21	30	12	26	15	0



BOLT SCREWING MACHINES.

No. 1.—Will screw bolts and tap nuts from ¼ inch to ¾ inch diameter, with 5 working taps and dies, tap and nut holders, overhead motion and screw keys. Approximate weight 10 Cwt. Price £48

No. 2.—Will screw bolts and tap nuts from ¾ inch to 1½ inches diameter, with 7 working taps and dies, tap and nut holders, overhead motion and screw keys. Approximate weight 16 Cwt Price £64

NUT SHAPING MACHINE.

Marland's Patent Nut Shaping Machine, with 2 slotting tools to shape up to 4 inches, overhead motion and screw keys . . . . Price £53

STEAM HAMMERS.

No. 1.—1½ Cwt. Overhanging Double-acting Steam Hammer to work self-acting or by hand. Price £53

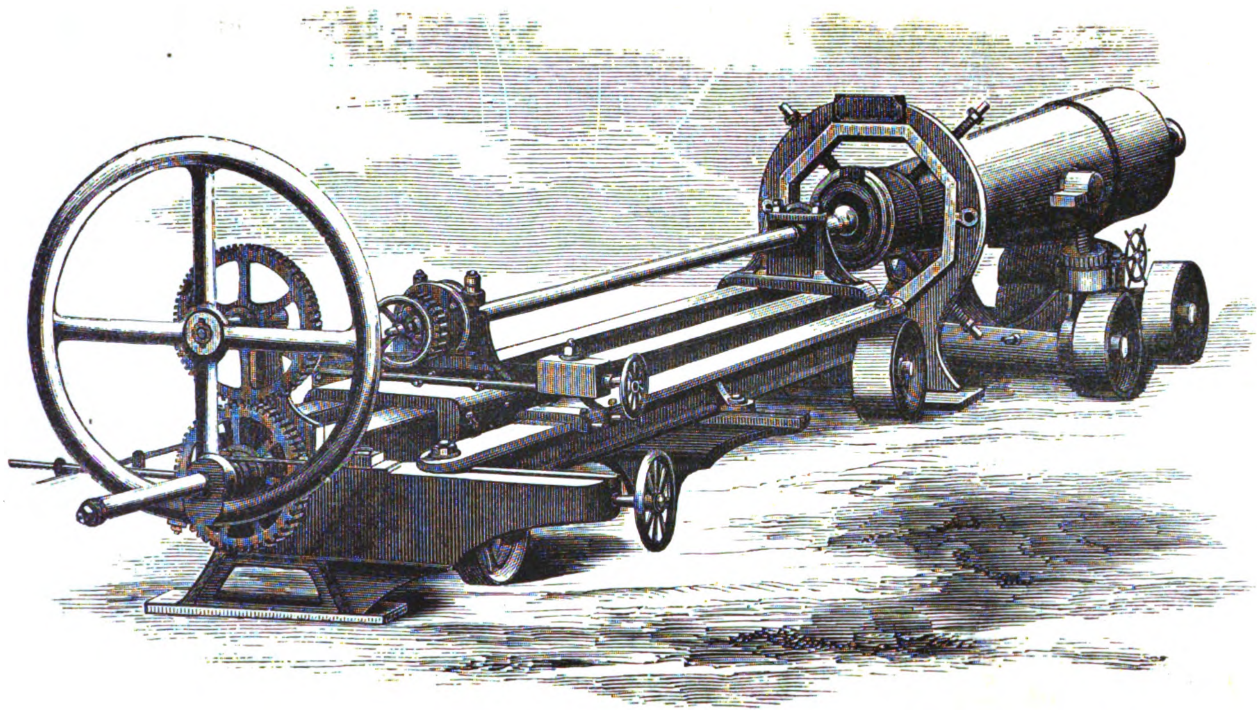
No. 2.—2½ Cwt. Overhanging Double-acting Steam Hammer to work self-acting or by hand, with loose anvil block. Approximate weight 42 Cwt. . . . . Price £74

No. 3.—3½ Cwt. Hammer similar to No. 2. Approximate weight 60 Cwt. . . . Price £90

No. 4.—5 Cwt. Hammer similar to No. 2, without anvil block. Approximate weight 85 Cwt. Price £116

No. 5.—7½ Cwt. Hammer similar to No. 2, without anvil block. Approximate weight 110 Cwt. Price £154

No. 6.—10 Cwt. Hammer similar to No. 2, without anvil block. Approximate weight 130 Cwt. Price £170



VAVASSEUR'S PATENT TRANSPORTABLE MACHINE FOR RIFLING CANNON.

THIS Machine can be worked either by hand or steam power; will rifle guns of all sizes, with any twist, number, and shape of grooves; is fitted with wheels so as to be readily removed from one place to another; is adapted for rifling guns on board ship or in fortresses, without moving the gun from its carriage, and is supplied with a carriage for rifling dismantled ordnance. Price and particulars on application.

PLATE BENDING AND STRAIGHTENING MACHINES.

No. 1 will take in plates 6 feet wide; the rollers are each 10 inches diameter, and are fitted with reversing motion. Approximate weight 80 cwt. . . *Price* £100

No. 2 will take in plates 8 feet wide; the top roller is 12 inches diameter, and the bottom rollers are 10 inches diameter, fitted with reversing motion. Approximate weight 130 cwt. . . . . *Price* £160

No. 3 will take in plates 10 feet wide; the top roller is 14 inches diameter, and bottom rollers are 12 inches diameter, fitted with reversing motion. Approximate weight 170 cwt. . . . . *Price* £215

No 4 will take in plates 12 feet wide; the top roller is 17 inches diameter, and the bottom rollers are 15 inches diameter, fitted with reversing motion. Approximate weight 240 cwt. . . . . *Price* £255

No. 5 will take in plates 12 feet long; and the top roller is made to draw out, through one end of the Machine, so as to get out objects bent to a complete circle, such as Masts, Yards, Funnels, &c.; the rollers are 7½ inches diameter, made of steel, and fitted with reversing motion. Approximate weight 120 cwt. *Price* £160

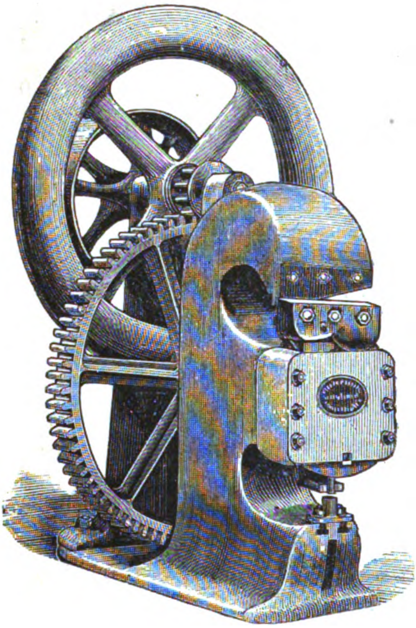
ANGLE AND BAR IRON BENDING AND STRAIGHTENING MACHINES.

No. 6 Machine, with cam motion to work by power, will bend or straighten any section of bar iron. Approximate weight 82 cwt. . . . . . . *Price* £90

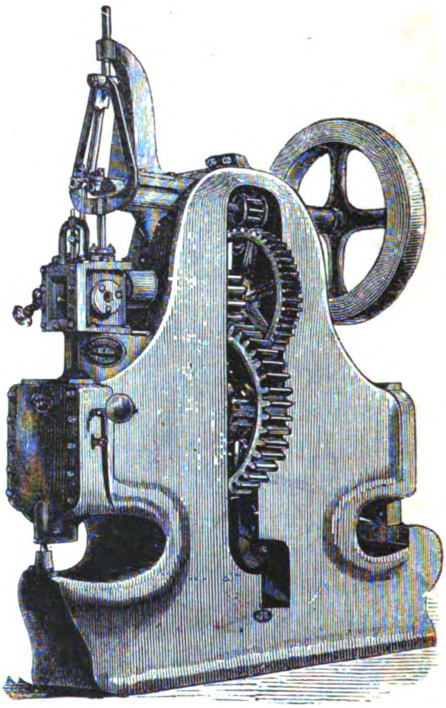
No. 7 Machine, with screw to work by hand; and the jaw is 4 feet 6 inches long, fitted with quick return motion, and can be reversed without stopping the Machine. Approximate weight 58 cwt. . . . . *Price* £64

No. 8 Hydraulic Machine, with jaw 8 feet long. The ram is 6 inches diameter, and the two gun-metal pumps, each 1 inch diameter, can be worked by hand or power. Approximate weight 71 cwt. . . . . *Price* £105

KEEL BENDING MACHINE will bend plates 12 feet long. Approximate weight 134 cwt. . . . . *Price* £138



No. 2.



No. 9.

PUNCHING AND SHEARING MACHINES.

No. 1 will punch and shear, on one side, plates up to ½ inch thick, and will take in 10 inches from the edge. Approximate weight 38 cwt. . . . . Price £48

No. 2 will punch and shear, on one side, plates up to ⅝ inch thick, and will take in 10 inches from the edge. The shear is set at an angle so as to cut long bars as well as plates. Approximate weight 40 cwt . . . . Price £58

No. 3 will punch and shear, on one side, plates up to 1 inch thick, and will take in 14 inches from the edge. The shear is set at an angle so as to cut long bars as well as plates. Approximate weight 77 cwt . . . . Price £90

No. 4.—The punch is on one side, and the shear on the other; will punch and shear plates up to ⅝ inch thick, and will take in 14 inches from the edge; fitted with stop motion for the punch, one pair of shears, and one punch and die. Approximate weight 85 cwt. . . . . Price £100

No. 5.—The punch is on one side, and the shear on the other; will punch and shear plates to ⅞ inch thick, and will take in 14 inches from the edge; fitted with stop motion for the punch, one pair of shears, and one punch and die. Approximate weight 100 cwt . . Price £127

No. 6.—The punch is on one side, and the shear on the other; will punch and shear plates up to 1 inch thick, and will take in 18 inches from the edge; fitted with stop motion for the punch, one pair of shears, and one punch and die. Approximate weight 141 cwt. Price £160

No. 7 is similar to No. 6, but is proportioned to punch and shear plates up to 1¼ inches thick, and will take in 22 inches from the edge. Approximate weight 250 cwt. . . . Price £275

No. 8.—The same Machine with Engine, diameter of cylinder 9 inches. . . Price £315

No. 9 is similar to No. 6, but is proportioned to punch and shear plates 1½ inches thick, and will take in 26 inches from the edge. Approximate weight 300 cwt. . . . . Price £320

No. 10.—The same Machine with Engine, diameter of cylinder 10 inches . . . Price £365

No. 11.—The punch is on one side, and the shear on the other; and there is a shear in the middle to cut angle irons up to 4 inches on the side. This Machine will punch and shear plates up to 1 inch thick, and will take in 18 inches from the edge; fitted with stop motion for the punch, one pair of shears, and one punch and die. Approximate weight 150 cwt. Price £180

No. 12 is similar to No. 8, but is proportioned to punch and shear plates up to 1¼ inches thick, and will take in 22 inches from the edge, and to shear angle irons up to 5 inches on the side. Approximate weight 260 cwt. . . . . Price £295

No. 13.—The same Machine with Engine, diameter of cylinder 9 inches. . . . Price £335

No. 14 is similar to No. 8, but is proportioned to punch and shear plates up to 1½ inches thick, and to shear angle irons up to 6 inches on the side, or flat bars 12 inches broad. Approximate weight 320 cwt. Price £350

No. 15.—The same Machine with Engine, diameter of cylinder 10 inches. . . . Price £395

BAR AND ANGLE IRON SHEARING AND PUNCHING MACHINES.

No. 16.—Machine, with stop motion, to shear bars up to 1½ inches thick. Approximate weight 40 cwt. . . . . Price £53

No. 17.—Machine, with stop motion, to shear bars up to 1¼ inches thick, and to punch holes through plates ⅝ inch thick, and will take in 6 inches from the edge. Approximate weight 44 cwt. . . . . Price £64

No. 18.—Single Lever Punching or Shearing Machine, will punch or shear plates up to 1 inch thick, and take in 24 inches from the edge. Approximate weight 105 cwt. . . Price £95

No. 19.—Double Lever Punching and Shearing Machine, will punch plates up to 1 inch thick on one side, and shear on the other; will take in 24 inches from the edge; and the punch is fitted with stop motion. Approximate weight 183 cwt. . . . . Price £190

No. 20.—The same Machine with Steam Engine. . . . . Price £235

No. 21.—Horizontal Angle Iron Punching Machine, with stop motion to the punch, will punch holes through 1 inch plates. Approximate weight 64 cwt. . . . . Price £90

No. 22.—Double Horizontal Angle Iron Punching Machine, with stop motion to the punches, will punch holes through plates 1 inch thick. Approximate weight 98 cwt. . . . Price £127
This machine may be also used for rivetting deck beams, &c.

No. 23 is similar to No. 22, but has one angle shear. Approximate weight 104 cwt. Price £148

No. 24 is similar to No. 22, but has right and left hand angle shears, and is proportioned to cut angle irons 5 inches on the side. Approximate weight 122 cwt. . . . Price £170

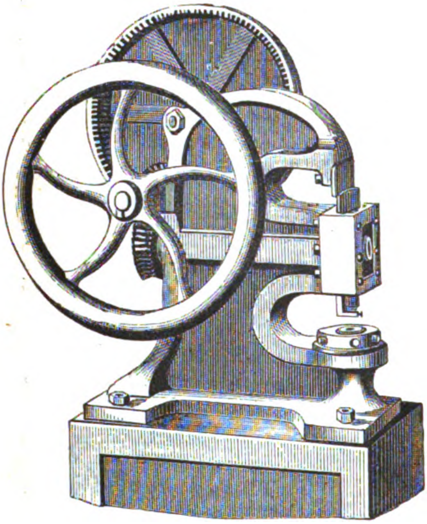
No. 25.—Single Angle Iron Shearing Machine, with stop motion, and proportioned to cut angle irons up to 8 inches on the side. Approximate weight 90 cwt. . . . . . . Price £100

No. 26.—Double Scrap Cutting Machine, with shears 8 inches wide, will cut bars up to 2 inches thick, and 6 inches wide. Complete with Steam Engine, cylinder 9 inches diameter and 12 inches stroke. Approximate weight 192 cwt. . . . . Price £235

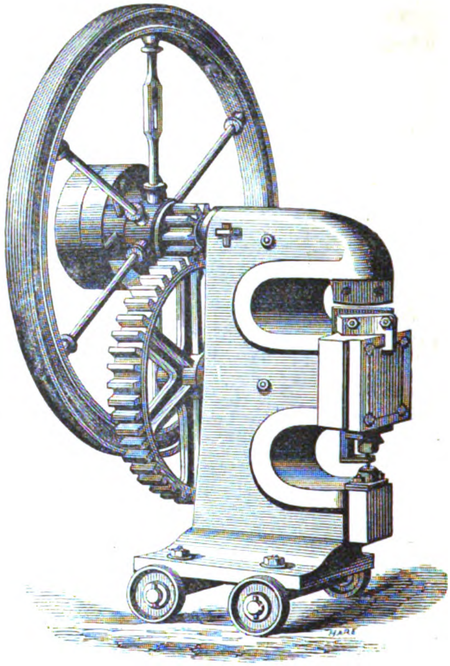
SCREW PUNCHING MACHINE.

No. 27.—Screw Punching Machine to fix on a bench or stool, and adapted for punching holes in plates ¼ inch thick, gulletting saws, &c. Approximate weight 5 cwt. . . . . Price £14

No. 28.—A similar Machine, but proportioned to punch holes in plates ⅜ inch thick. Approximate weight 12¼ cwt. Price £19



No 31.



No 32.

PORTABLE PUNCHING, SHEARING, AND DRILLING MACHINES WITH STEAM ENGINE AND BOILER COMBINED.

No. 29.—The Machines are mounted on a wrought-iron carriage with wheels, and an Engine of about 4-horse power, boiler with all necessary fittings, feed pump, water tank, and water heating apparatus, and the whole is easily moved about a yard or shop. The Machine will punch and shear on one side, and drill on the other, plates 1 inch thick, and will take in 18 inches from the edge. Approximate weight 153 cwt. . . . . Price £295

No. 30 is similar to No. 29, but it is fitted with apparatus to *punch on one side* and *shear on the other side*, plates up to 1 inch thick and 18 inches from the edge, and the Geared Drilling Machine has a spindle 2¼ inches diameter with 12 inches range. Complete, with carriage, engine, &c. as described above. Approximate weight 200 cwt . . . . . . Price £370

PORTABLE PUNCHING, AND SHEARING MACHINES FOR HAND-POWER.

No. 31 will punch and shear plates up to ½ inch thick, and the shear is set at an angle to cut plates or long bars. It is complete with one pair of shears, one punch and die. . Price £17

No. 32 will punch and shear plates up to ⅝ inch thick, and 8 inches from the edge. The cutters are placed at an angle similar to No. 31; each machine is fitted with heavy fly-wheel and handle, and with fast and loose pulleys if required for steam power, one pair of shears, one punch and die, approximate weight 12 cwt. . . Price £27. . Price without wheels £25

No. 32.—PORTABLE PUNCHING AND SHEARING MACHINE, to punch and shear ½-in. thick, 9 inches from the edge.

Weight 17 cwt. Price £34. Without Wheels, £32.

No. 32.—Ditto ditto to punch and shear ⅝-in. thick, 12 inches from the edge.

Weight 25 cwt. Price £42 10s. Without Wheels, £40.

LEVER PUNCHING AND SHEARING MACHINES

FOR HAND POWER.

No. 33.—To fix on a work bench, and suitable for Whitesmiths, Coppersmiths, or any light purpose, fitted with loose lever handle, 1 punch and die, and 1 pair of shears.

		£	s.	d.
To punch 5/16 hole 3/16 thick, and shear ⅛-in. thick	Price	3	0	0
To punch ⅜ × ¼ in., and shear ¼ in.	,,	6	0	0
To punch ⅜ × 5/16 ,, and shear 5/16 ,, ...	,,	8	0	0
To punch 7/16 × ⅜ ,, and shear 5/16 ,, ...	,,	15	0	0
No 34.—MACHINE, to punch ⅜ × ¼ in. and shear 3/16 in.	,,	8	0	0
Ditto to punch ⅜ × ⅜ ,, and shear 5/16 ,, ...	,,	12	0	0
Ditto to punch 9/16 × ⅜ ,, and shear ⅜ ,, ...	,,	18	0	0

SMALL PLANING MACHINES

FOR HAND POWER.

No. 10	Will plane 4 × 12 in.	Price £25 0 0.	Weight about	265 lbs.
,, 11	Ditto 6 × 15¾ ,,	,, 32 0 0.	,, ,,	4¾ cwt.

These are useful Machines in small workshops.

For larger sizes, see page 242.

BENCH DRILLING MACHINES

FOR HAND POWER.

These are very good and useful tools in small workshops where there is no steam power—they are complete with fly-wheel, handle, sliding vice, and self-feeding motion.

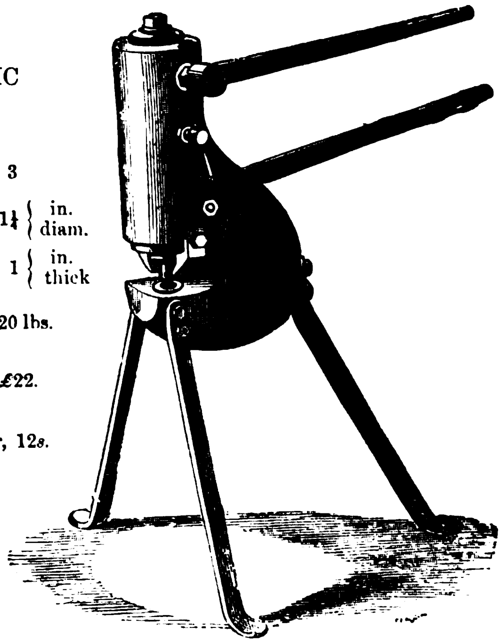
		Price £	s.	d.	Approximate Weight.
No. 1.	Will drill ⅝-in. hole	6	0	0	. . . 120 lb.
,, 2.	With moveable circular table, fast and slow speed wheels, will drill ⅝-in. hole	6	6	0	. . . 140 ,,
,, 3.	With fast and slow speed wheels, will drill 1-in. hole	8	10	0	. . . 200 ,,
,, 4.	Ditto ditto ditto 1¼ ,,	11	0	0	. . . 286 ,,
,, 5.	Ditto ditto ditto 1½ ,,	14	0	0	. . . 400 ,,

PATENT HYDRAULIC PUNCHING BEAR.

Size No.	1	2	3	
Will punch holes .	¾	1	1¼	in. diam.
Through plate . .	½	¾	1	in. thick
Weight of Punching Bear . .	64 lbs.	120 lbs.	320 lbs.	
Price	£12	£15	£22.	

Extra Punch and Die, per pair, 12*s*.

Space from centre of Punch to back of gap, 1¾ in.



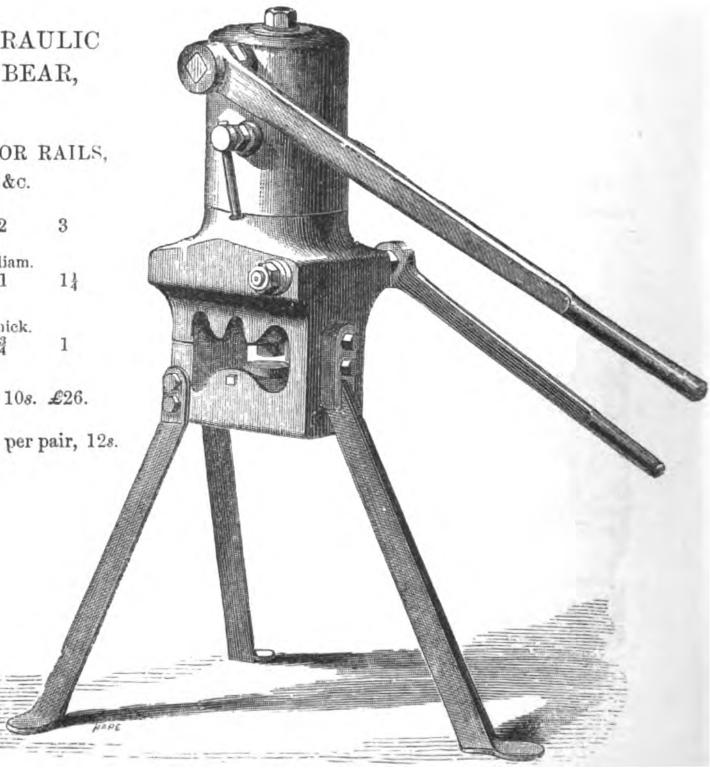
PATENT HYDRAULIC PUNCHING BEAR,

WITH

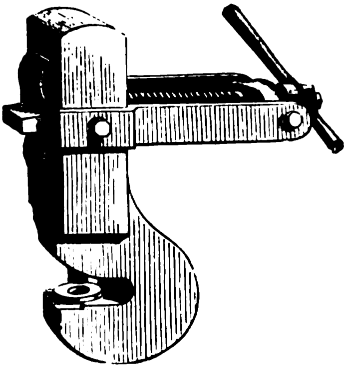
CLOSE MOUTH FOR RAILS, GIRDERS, &c.

No. . . .	1	2	3
Will punch holes. .	¾	in. diam. 1	1¼
Through plate. .	½	in. thick. ¾	1
Price . .	£14	£17 10*s*.	£26.

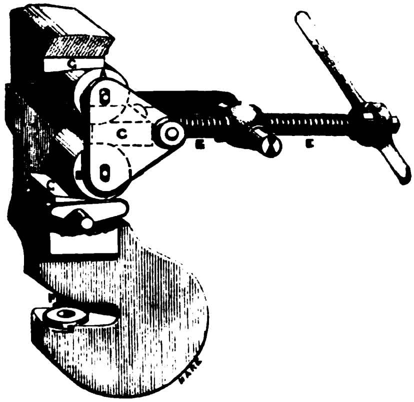
Extra Punch and Die, per pair, 12*s*.



THE PATENT ROLLER PUNCH.



ELEVATION.

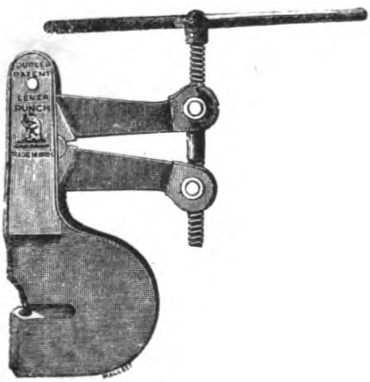


SHOWING THE WORKING PARTS.

POWER.			PRICES.			
Sizes.	To Punch	Gap.	Approximate Weights.	£	s.	d.
No. 1,	$\frac{3}{4}$ in. in $\frac{3}{8}$ in. plate,	$1\frac{3}{4}$ in.	... 34 lb. ...	9	0	0
No. 2,	$\frac{3}{4}$,, $\frac{3}{8}$,,	3 in.	... 44 lb. ...	9	15	0
No. 3,	$\frac{3}{4}$,, $\frac{5}{8}$,,	$1\frac{3}{4}$ in.	... 75 lb. ...	12	10	0
No. 4,	$\frac{3}{4}$,, $\frac{5}{8}$,,	3 in.	... 128 lb. ...	13	10	0
No. 5,	$\frac{7}{8}$,, $\frac{3}{4}$,,	$1\frac{3}{4}$ in.	... 135 lb. ...	16	0	0
No. 6,	for punching railway bars, $1\frac{3}{16}$ in. in $\frac{5}{8}$ in. plate.		... about $5\frac{1}{2}$ cwt. ...	30	0	0

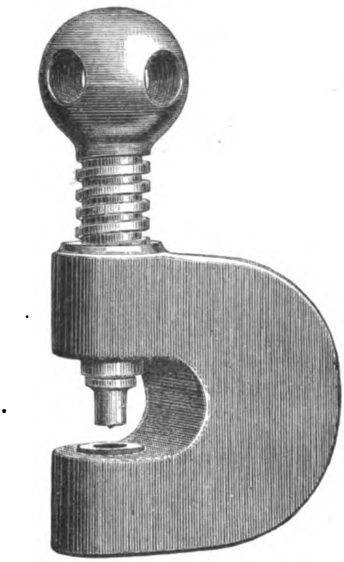
Larger Sizes to Order.

This is a simple, durable, and powerful punch, and can be worked by one man. The weak points in other punches have been avoided in the construction of this tool.



THE PATENT "DUPLEX" LEVER PUNCH.

	To Punch.	Approximate Weight.	Price. £	s.	d.
No. 1	...... $\frac{1}{2} \times \frac{1}{4}$ in	...... 25 lbs.	8	0	0
2	..... $\frac{3}{4} \times \frac{3}{8}$,,	...... 42 lbs.	9	0	0
3	..... $\frac{3}{4} \times \frac{5}{8}$,,	...... [illegible]0 lbs.	12	0	0

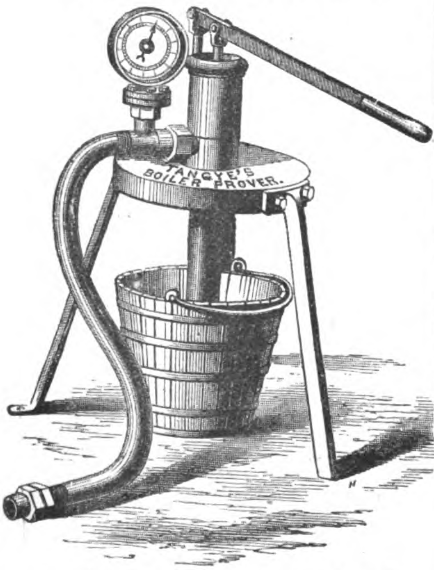


IMPROVED STEEL PUNCHING BEAR.

THESE Punching Bears are made of the best quality of Steel, and from their LIGHTNESS, STRENGTH, and DURABILITY, are much superior to the ordinary *Iron* Bears. They may be used by a common labourer without fear of breakage, and are so light and portable that they may be easily carried about.

Size.	Approx. Weight.	To Punch	Price nett, including Punch and Die.
No. 1.	—20 lbs.	$\frac{3}{4}$ in. hole in $\frac{5}{16}$ in. plate	£3 17 6
No. 2.	—38 lbs.	$\frac{3}{4}$ in. ,, $\frac{1}{2}$ in. ,,	£4 10 0
No. 3.	—56 lbs.	$\frac{3}{4}$ in. ,, $\frac{3}{4}$ in. ,,	£5 0 0

PORTABLE TEST PUMP.



No. 1.—PORTABLE BOILER PROVER, for Boilers, Pipes, Tanks, &c.

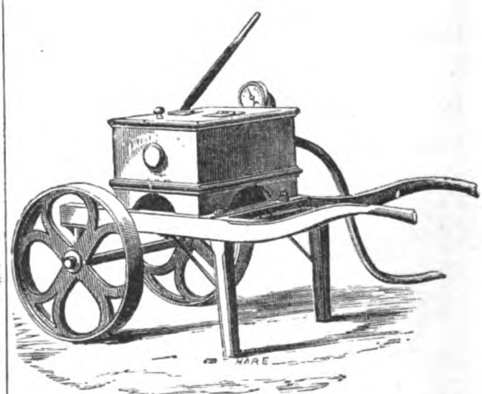
Fitted with Gauge to register to 200 lbs. pressure, Suction Pipe and Union Connection, a piece of flexible delivery hose, terminating with a $\frac{3}{4}$ in. boiler screw and union, as shown.

Price, complete . . . £8.

PORTABLE TEST PUMP ON WHEELS,

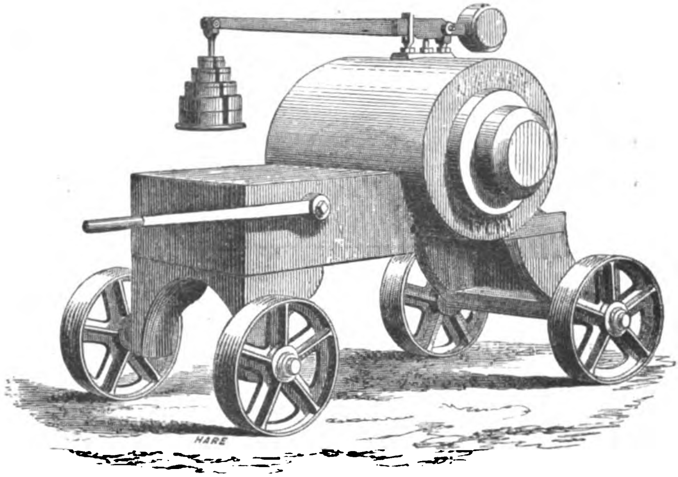
FOR PROVING PIPES, BOILERS, &C.

No. 2.



Price of Boiler Prover to 200 lbs. per inch, with Gauge and Barrow . . . £11 11 0

Ditto, ditto, with Gauge without Barrow £10 0 0



HYDRAULIC GIRDER TESTER.

	£	s.	d.
To prove to a strain of 50 tons	20	0	0
„ „ 100 „	30	0	0
„ „ 150 „	35	0	0

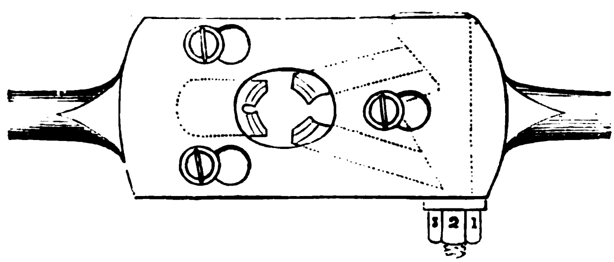
HYDRAULIC WAGGON TIPPER.

For loading Coal Vessels, a simple and cheap machine which can be worked by hand or steam power.

Price for hand power, complete with 2 pumps, to tip a 12-ton coal waggon, £40
Price for steam power, „ „ „ £45

HYDRAULIC PRESS
FOR
SHIFTING AND PUTTING RAILWAY WHEELS ON THEIR AXLES.

	£	s.	d.
Press mounted on wheels for narrow gauge wheels and axles . .	26	10	0
„ „ for broad gauge wheels and axles . .	31	10	0
If with safety valve attached, to indicate the pressure, extra . .	2	0	0



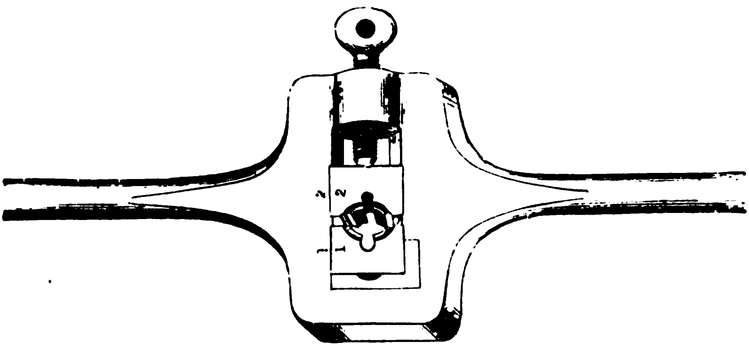
(No. 1.) WHITWORTH'S PATENT HANDSCREWING APPARATUS.

Including the Guide Screw Stock, Dies, Working Taps, as enumerated; the Master Taps for Cutting Dies, Tap Wrenches, and Box are given separately.

Size of Blocks.	Range.	Patent Stock, Dies, and Taper Tap to each size.	Patent Stock, Dies, Taper and plug Taps to each size.	Patent Stock, Dies, Taper, 2nd and Plug Taps to each size.	One Master Tap to each size.	Case Hardened Wrenches to suit each Tap.	Box.
	Inch.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
A	1/4 3/8	2 17 9	3 3 0	3 8 6	0 7 6	0 7 6	0 9 9
,,	3/8 3/4 7/16	3 5 0	3 14 0	4 2 9	0 11 9	0 7 6	0 9 9
,,	3/16 1/4 5/16 3/8	3 12 9	4 3 6	4 14 0	0 15 0	0 7 6	0 9 9
,,	1/4 5/16 3/8 7/16	3 13 3	4 4 6	4 15 6	0 16 6	0 9 0	0 9 9
,,	3/16 1/4 5/16 3/8 7/16	4 0 6	4 14 6	5 8 6	0 19 9	0 9 0	0 9 9
B	1/4 1/2	3 6 3	3 12 9	3 19 0	0 8 6	0 9 0	0 11 9
,,	1/2 5/8	3 7 9	3 15 9	4 3 9	0 11 9	0 9 6	0 11 9
,,	1/4 3/8 1/2	3 14 9	4 3 9	4 12 9	0 12 9	0 9 6	0 11 9
,,	3/8 7/16 1/2	3 15 3	4 4 9	4 14 6	0 14 6	0 10 0	0 11 9
,,	3/8 1/2 5/8	3 16 6	4 7 0	4 17 9	0 16 0	0 12 6	0 11 9
,,	1/4 3/8 1/2 5/8	4 4 9	4 18 0	5 11 6	0 19 3	0 12 6	0 11 9
,,	3/8 7/16 1/2 5/8	4 5 3	4 19 3	5 13 0	1 1 0	0 12 6	0 11 9
,,	1/4 5/16 3/8 7/16 1/2	4 11 9	5 6 0	6 0 9	1 2 0	0 16 0	0 11 9
,,	1/4 5/16 3/8 7/16 1/2 5/8 . . .	5 2 0	6 0 9	6 19 3	1 8 6	0 16 6	0 11 9
C	1/2 3/4	4 14 6	5 3 6	5 12 6	0 12 9	0 16 0	0 17 0
,,	3/4 1	4 18 0	4 9 9	6 3 9	0 18 3	0 19 9	0 17 0
,,	1/2 5/8 3/4	5 6 9	6 0 0	6 13 6	0 19 3	1 0 9	0 17 0
,,	5/8 3/4 7/8	5 9 6	6 5 6	6 10 9	1 3 0	1 0 9	0 17 0
,,	1/2 3/4 1	5 10 0	6 6 6	7 3 0	1 3 9	1 4 0	0 17 0
,,	3/4 7/8 1	5 12 6	6 11 9	7 11 0	1 7 3	1 4 0	0 17 0
,,	1/2 5/8 3/4 7/8	6 1 0	7 0 9	8 0 6	1 8 6	1 4 0	0 17 0
,,	5/8 3/4 7/8 1	6 4 9	7 8 6	8 11 9	1 13 9	0 15 0	0 17 0
,,	1/2 5/8 3/4 7/8 1	6 16 9	8 3 6	9 11 0	1 18 6	1 5 9	0 17 0
D	3/4 1 1 1/4	6 17 0	8 0 0	9 3 0	1 13 3	1 5 9	1 3 6
,,	1 1 1/8 1 1/4	7 0 6	8 6 6	9 12 6	2 2 0	1 18 6	1 3 6
,,	1 1 1/4 1 1/2	7 5 9	8 17 0	10 8 9	2 4 6	1 10 6	1 3 6
,,	1 1/4 1 3/8 1 1/2	7 10 0	9 5 9	11 1 6	2 11 6	1 9 6	1 3 6
,,	3/4 1 1 1/4 1 1/2	8 0 6	9 17 6	11 14 0	2 12 6	1 14 6	1 3 6
,,	1 1 1/8 1 1/4 1 3/8	8 1 9	9 19 6	11 17 6	2 15 6	1 13 9	1 7 0
,,	1 1/8 1 1/4 1 3/8 1 1/2	8 8 0	10 12 0	12 17 0	3 4 0	1 12 0	1 7 0
,,	3/4 7/8 1 1 1/8 1 1/4	8 11 3	10 9 0	12 7 0	2 15 0	1 18 0	1 7 0
,,	1 1 1/8 1 1/4 1 3/8 1 1/2	9 5 0	11 17 0	14 8 9	3 15 0	1 18 0	1 7 0
,,	3/4 7/8 1 1 1/8 1 1/4 1 3/8 1 1/2.. .	10 16 0	13 19 6	17 3 0	4 11 6	1 18 0	1 7 0

WHITWORTH'S PATENT HANDSCREWING APPARATUS.—*continued.*

Size of Blocks.	Range.	Patent Stock, Dies, and Taper Tap to each size.	Patent Stock Dies, Taper, and Plug Taps to each size.	Patent Stock, Dies, Taper, 2nd and Plug Taps to each size.	One Master Tap to each size.	Case Hardened Wrenches to suit each Tap.	Box.
	Inch.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d
E	1¼ 1½ 1¾	9 12 6	11 15 0	—	3 0 0	1 18 0	1 17 6
,,	1 1½ 2	9 16 6	12 2 0	—	4 4 0	2 6 6	1 17 6
,,	1⅛ 1¾ 2	10 7 0	13 3 6	—	3 17 0	2 6 6	1 17 6
,,	1¼ 1½ 1¾ 2	11 10 0	14 17 0	—	4 12 0	3 3 6	1 17 6
,,	1⅝ 1¾ 1⅞ 2	12 3 3	16 3 6	—	5 9 0	3 3 6	1 17 6
,,	1 1¼ 1½ 1¾ 2	12 10 0	16 4 6	—	5 2 6	3 3 6	2 3 0
,,	1⅛ 1¼ 1⅜ 1½ 1⅝ 1¾ . . .	13 7 3	17 6 0	—	5 12 0	3 6 6	2 3 0
,,	1⅛ 1⅝ 1¾ 1⅞ 2	13 9 9	18 5 0	—	6 8 0	2 6 6	2 3 0
,,	1⅛ 1¼ 1⅜ 1½ 1⅝ 1¾ 1⅞ 2.	16 18 6	23 3 0	—	8 13 0	3 3 6	2 3 0
,,	1 1⅛ 1¼ 1⅜ 1½ 1⅝ 1¾ 1⅞ 2	17 19 0	24 11 0	—	9 3 6	2 6 6	2 3 0
F	2½ 3	20 17 0	—	—	4 15 0	3 1 6	3 2 0
,,	2½ 2¾ 3	23 1 0	—	—	8 8 6	3 1 6	3 2 0
,,	2¼ 2½ 2¾ 3	25 6 0	—	—	10 7 0	3 1 6	3 2 0



(No. 2.) BEST QUALITY SCREW STOCKS, DIES, AND TAPS, FOR ENGINEERS.

All the Taps of Whitworth's thread, gauge, and pattern.

Series or range of sizes to Screw.	With 2 Taps to each size, Taper and Plug.	With 3 Taps to each size, Taper, Second & Plug.	Case Hardened Wrenches, to suit Taps.	Wood Case, Painted.
Inch.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
3/16 ¼ ⅜	0 19 0	1 5 0	0 3 6	0 3 9
3/16 ¼ 5/16 ⅜	1 3 6	1 10 0	0 3 6	0 3 9
⅛ 3/16 ¼ 5/16 ⅜	1 7 0	1 14 0	0 3 6	0 3 9
¼ ⅜ 7/16	0 19 6	1 7 0	0 5 0	0 4 0
¼ 5/16 ⅜ 7/16	1 3 0	1 12 0	0 5 0	0 4 0
3/16 ¼ 5/16 ⅜ 7/16	1 6 0	1 16 0	0 7 0	0 4 0
¼ ⅜ ½	1 1 0	1 8 0	0 5 0	0 5 0
¼ 5/16 ⅜ ½	1 5 6	1 14 0	0 5 0	0 5 0
¼ 5/16 ⅜ 7/16 ½	1 7 6	1 18 0	0 7 0	0 5 0
⅜ ½ ⅝	1 5 6	1 13 6	0 6 3	0 6 0
¼ ⅜ ½ ⅝	1 10 0	2 1 0	0 6 3	0 6 0
¼ ⅜ 7/16 ½ ⅝	1 14 0	2 7 0	0 7 6	0 6 0

(No. 2.) BEST QUALITY SCREW STOCKS, &c.—*continued.*

Series or range of sizes to Screw. Inch.	With 2 Taps to each size, Taper & Plug. £	s.	d.	With 3 Taps to each size, Taper, Second, & Plug. £	s.	d.	Case Hardened Wrenches, to suit Taps. £	s.	d.	Wood Case. Painted. £	s.	d.
1/2 5/8 3/4	1	8	0	1	18	0	0	7	6	0	9	0
3/8 1/2 5/8 3/4	1	17	0	2	7	0	0	7	6	0	9	0
3/8 7/16 1/2 5/8 3/4	2	3	6	3	0	0	0	7	6	0	9	0
5/8 3/4 7/8	1	15	0	2	5	6	0	9	0	0	12	0
1/2 5/8 3/4 7/8	2	3	6	2	18	6	0	9	0	0	12	0
7/16 1/2 5/8 3/4 7/8	2	11	6	3	8	6	0	9	0	0	12	0
3/4 7/8 1	2	0	0	2	13	6	0	12	0	0	13	6
5/8 3/4 7/8 1	2	10	0	3	7	0	0	12	0	0	13	6
1/2 5/8 3/4 7/8 1	2	18	0	3	17	6	0	14	0	0	13	6
7/8 1 1 1/8	2	4	0	3	1	6	0	13	6	0	16	0
3/4 7/8 1 1 1/8	2	19	0	3	17	0	0	15	6	0	16	0
5/8 3/4 7/8 1 1 1/8	3	7	0	4	10	0	0	15	6	0	16	0
1 1 1/8 1 1/4	2	8	0	3	7	0	0	15	0	0	19	0
7/8 1 1 1/8 1 1/4	3	3	0	4	5	0	0	15	0	0	19	0
3/4 7/8 1 1 1/3 1 1/4	3	15	0	5	1	0	0	17	6	0	19	0
1 1/8 1 1/4 1 3/8	2	17	0	3	19	0	1	0	0	1	0	0
1 1 1/8 1 1/4 1 3/8	3	10	0	4	17	6	1	0	0	1	0	0
7/8 1 1 1/8 1 1/4 1 3/8	4	0	0	5	12	0	1	3	0	1	0	0
1 1 1/4 1 1/2	3	5	6	4	8	0	1	3	0	1	3	0
1 1/4 1 3/8 1 1/2	3	9	6	4	15	0	1	3	0	1	3	0
1 1/8 1 1/4 1 3/8 1 1/2	4	1	6	5	14	0	1	3	0	1	3	0
1 1 1/8 1 1/4 1 3/8 1 1/2	4	15	0	6	12	0	1	7	0	1	3	0
1 1/4 1 1/2 1 3/4	4	13	6	6	10	0	1	5	6	1	7	0
1 1/4 1 1/2 1 5/8 1 3/4	5	13	6	7	15	0	1	5	6	1	7	0
1 1/4 1 3/8 1 1/2 1 5/8 1 3/4	6	11	6	9	0	0	1	12	0	1	7	0
1 1/8 1 1/4 1 3/8 1 1/2 1 5/8 1 3/4	7	9	6	10	4	0	1	12	0	1	7	0
1 1/2 1 3/4 2	5	15	0	7	13	6	1	13	6	1	16	0
1 1/4 1 1/2 1 3/4 2	7	1	6	8	16	0	1	13	6	1	16	0
1 5/8 1 3/4 1 7/8 2	7	7	0	9	9	0	1	2	0	1	16	0
1 1/2 1 5/8 1 3/4 1 7/8 2	8	12	0	11	18	0	1	13	6	1	16	0
1 3/4 2 2 1/4	6	17	0	9	9	6	1	5	0	2	7	0
1 1/2 1 7/8 2 2 1/4	8	3	6	11	10	0	1	10	0	2	7	0
2 2 1/4 2 1/2	8	0	0	11	9	0	2	3	6	2	7	0
1 3/4 2 2 1/4 2 1/2	9	13	6	14	8	0	2	3	6	2	7	0
2 2 1/8 2 1/4 2 3/8 2 1/2	11	13	6	17	13	6	2	3	6	2	7	0

No. 3.) BEST SCREW STOCKS, DIES, AND TAPS, FOR ENGINEERS, &c.

With Dies, Taper and Plug Taps, Tap Wrenches, Lever, &c.
Fitted in Painted Wood Cases.

The cases in each series are priced separately, so that any selection may be made; and two sets of Stocks, &c. may be had fitted into one case.

Series No. 1, complete in 2 cases	1/4 3/8 1/2 5/8 3/4 60s.	7/8 1 1 1/8 1 1/4 1 1/2 140s.			£10 0s. 0d.
Series No. 2, complete in 3 cases	1/4 3/8 1/2 5/8 42s. 6d.	3/4 7/8 1 1 1/8 87s. 6d.	1 1/4 1 3/8 1 1/2 1 5/8 1 3/4 190s.		£16 0s. 0d.
Series No. 3, complete in 3 cases	1/4 5/16 3/8 7/16 1/2 40s.	5/8 3/4 7/8 1 75s. 6d.	1 1/8 1 1/4 1 3/8 1 1/2 1 3/4 187s.		£15 2s. 6d.
Series No. 4, complete in 4 cases	3/16 1/4 5/16 3/8 30s. 6d.	1/2 5/8 3/4 44s. 6d.	7/8 1 1 1/8 1 1/4 96s.	1 1/2 1 5/8 1 3/4 2 215s.	£19 6s. 0d.
Series No. 5, complete in 4 cases	3/16 1/4 5/16 3/8 7/16 37s.	1/2 5/8 3/4 7/8 1 85s. 6d.	1 1/8 1 1/4 1 3/8 1 1/2 127s.	1 5/8 1 3/4 1 7/8 2 205s. 6d.	£22 15s. 0d.

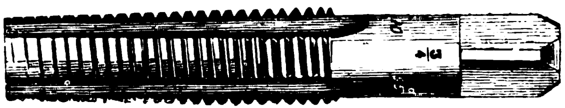
Warranted of Whitworth's Thread and Gauge, as used by all Engineers, and as supplied to Her Majesty's Dockyards, &c.

PRICE OF WORKING TAPS, MASTER TAPS, AND SCREW TOOLS,

Added to the above cases when ordered, extra.

	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2 Inches.
Extra Working Taps, each / ,, Master ,, ,,	1/6	1/9	1/9	2/0	2/4	2/9	3/4	4/0	4/9	5/6	6/6	7/6	8/6	10/0
Screw Tools, per pair		2/9			3/0			3/6				4/0		

	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3 Inches.
Extra Working Taps, each / ,, Master ,, ,,	11/6	12/9	14/9	17/6	20/0	22/0	25/6	29/0	33/6	37/0	41/6	47/0
Screw Tools, per pair		5/0				5/9				6/6		



(No. 4.) PRICE OF BEST ENGINEERS' TAPS.

Cut to WHITWORTH'S Pitch, and made of the best Cast Steel.

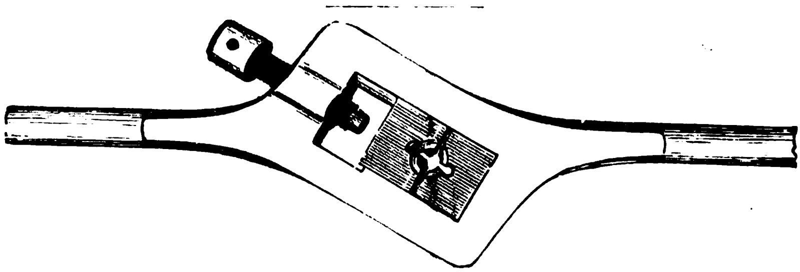
CROSS'S RATCHET DIE.

Diameter in Inches	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2
Working Taps, each	2/0	2/3	2/3	2/9	3/0	3/3	4/0	4/9	5/6	6/6	7/6	9/3	10/9	12/9	14/6	16/9	19/3	21/6	23/6	27/9	32/0	37/6
Master Taps, ,,	2/3	2/9	3/3	3/9	4/6	4/9	5/6	7/0	8/0	9/3	10/3	11/9	13/6	17/0	19/3	21/6	24/9	28/9	32/0	36/6	43/0	48/0
Machine Taps, ,,	2/3	2/9	3/3	3/9	4/6	4/9	5/6	7/0	8/0	9/3	10/3	11/9	13/6	17/0	19/3	21/6	24/9	28/9	32/0	36/6	43/0	48/0

CROSS'S PATENT RATCHET DIE FOR THREADING FIXED PIPES.

To take 1/2 in., 3/4 in., and 1 in. Pipe £3 5 0

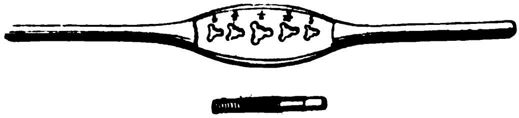
Guides and Dies 1/2, 3/4, and 1 in. per pair 0 10 6



(No. 5.) SCREW STOCKS AND DIES FOR SCREWING IRON GAS TUBE

With Taper and Plug Taps to each size.

To screw				1/8	1/4	Gas Tube	0	15	0
,,				1/4	3/8	,,	0	16	6
,,			1/8	1/4	3/8	,,	1	0	6
,,				3/8	1/2	,,	1	3	0
,,			1/4	3/8	1/2	,,	1	8	0
,,		1/8	1/4	3/8	1/2	,,	1	14	6
,,			3/8	1/2	5/8	,,	1	17	0
,,					3/4	,,	1	6	0
,,			1/2	5/8	3/4	,,	2	1	0
,,			3/8	1/2	3/4	,,	2	1	0
,,		1/4	3/8	1/2	3/4	,,	2	6	0
,,		3/8	1/2	5/8	3/4	,,	2	7	0
,,					1	,,	1	8	0
,,				3/4	1	,,	1	18	6
,,			1/2	3/4	1	,,	2	6	6
,,		3/8	1/2	3/4	1	,,	2	15	6
,,		1/2	5/8	3/4	1	,,	2	15	6
,,			3/4	7/8	1	,,	2	13	0
,,	1/4	3/8	1/2	3/4	1	,,	3	2	6
,,	1/2	5/8	3/4	7/8	1	,,	3	6	0
,,					1¼	,,	1	19	0
,,				1	1¼	,,	2	10	0
,,			3/4	1	1¼	,,	3	2	0
,,			7/8	1	1¼	,,	3	6	0
,,		1/2	3/4	1	1¼	,,	3	12	0
,,					1½	,,	2	19	6
,,				1¼	1½	,,	4	4	6
,,		1	1¼	1½	1½	,,	4	15	6
,,		3/4	1	1¼	1½	,,	5	8	6
,,		1/2	3/4	1	1¼	,,	5	17	6
,,				1½	1¾	,,	4	14	0
,,			1¼	1½	1¾	,,	5	3	0
,,		1	1¼	1½	1¾	,,	6	5	0
,,					2	,,	3	13	6
,,				1¾	2	,,	5	3	0
,,				1½	2	,,	4	17	0
,,			1½	1¾	2	,,	6	5	0
,,			1¼	1½	2	,,	6	1	0
,,		1	1¼	1½	2	,,	6	17	6
,,		1¼	1½	1¾	2	,,	7	3	0
,,					2¼	,,	4	8	0
,,				2	2¼	,,	6	8	0
,,			1½	2	2¼	,,	7	10	6
,,					2½	,,	5	3	0
,,				2¼	2½	,,	8	1	6
,,			2	2¼	2½	,,	9	18	0
,,					3	,,	8	16	0
,,				2½	3	,,	11	15	0
,,			2¼	2½	3	,,	14	13	6
,,			2½	2¾	3	,,	16	3	0



No. 6.) BEST LANCASHIRE DOUBLE HAND-SCREW PLATES FOR ENGINEERS, &c.

With 3 notches to each hole, and Fluted Taps.

Inch.	Four holes.	Five holes.	Seven holes.
3/8	0 10 6	0 12 0	0 13 0
1/2	0 12 6	0 14 0	0 15 6
5/8	0 17 0	0 19 0	1 1 0
3/4	1 0 6	1 4 0	1 7 6
7/8	1 5 0	1 7 6	1 12 6
1	1 9 6	1 12 0	1 17 6
1 1/8	1 12 0	1 17 6	2 4 6
1 1/4	2 3 0	2 6 6	2 16 0
1 1/2	2 11 0	2 14 6	3 5 0

LLOYD'S SOLID DIE STOCK,

For Screwing wrought-iron tubes to the required sizes, at ONE CUT.

Size of Stock.	Range of sizes, taken in Stock.	Price per Set with Dies, Taper & Plug Taps, to each size.	Price of Extra Dies.	Price of Extra Guides.
	Inch.	£ s. d.	s. d.	s. d.
A	1/4 3/8	1 2 0	3 6	1 6 each.
,,	1/8 1/4 3/8	1 10 0		
B	3/8 1/2	1 11 0	4 9	1 6 ,,
,,	1/4 3/8 1/2	1 18 0		
,,	1/8 1/4 3/8 1/2	2 6 6		
C	1/2 3/4	2 2 0	6 6	2 6 ,,
,,	3/8 1/2 3/4	2 12 0		
,,	1/4 3/8 1/2 3/4	3 4 0		
D	3/4 1	2 12 0	7 6	3 0 ,,
,,	1/2 3/4 1	3 3 0		
,,	3/8 1/2 3/4 1	3 17 0		
,,	1/4 5/8 3/4 1	3 18 6		
E	1 1 1/4	3 10 0	10 0	3 6 ,,
,,	3/4 1 1 1/4	4 10 0		
,,	1/2 3/4 1 1 1/4	5 8 0		
F	1 1/4 1 1/2	4 16 0	13 6	4 6 ,,
,,	1 1 1/4 1 1/2	6 0 0		
,,	3/4 1 1 1/4 1 1/2	7 4 0		
G	1 1/2 2	6 10 0	17 0	6 0 ,,
,,	1 1/4 1 1/2 2	8 0 0		
,,	1 1 1/4 1 1/2 2	9 10 0		
,,	1 1/4 1 1/2 1 3/4 2	10 5 0		

The Solid Die ensures each tube being screwed exact to size:—all the Dies and Guides are interchangeable, and can be replaced at any time.

The simple construction of this Stock, renders it almost impossible for it to get out of order, and owing to the introduction of the Guide, the tube must be screwed straight.

No. 1. **WROUGHT IRON TUBE CUTTER** with rotary steel knife and cast iron slides.

To cut wrought iron tube	¼ to 1 inch,	£0 10*s.* 6*d.*
,,	1 to 2 ,,	0 15*s.* 6*d.*
,,	2 to 3 ,,	1 12*s.* 0*d.*

Ditto if with wrought iron slides instead of cast iron 1*s.* 6*d.* to 3*s.* 0*d.* extra.

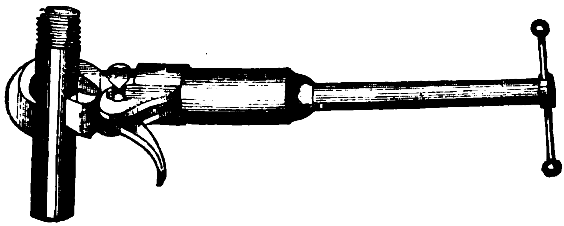
No. 2. **MAIN PIPE CUTTER** for cutting Cast Iron Main Pipes.

To cut Pipes	2 to 4	in. inside diameter,	£2 5*s.* 0*d.*
,,	4 to 6	,,	2 10*s.* 0*d.*
,,	5 to 8	,,	2 15*s.* 0*d.*
,,	9 to 10	,,	3 17*s.* 6*d.*

No. 3. **IMPROVED PIPE WRENCHES.**

To take from	¼ to ⅜	inch tube with	12	inch lever,	£0 12*s.* 0*d.*
,,	⅜ to 1¼	,,	18	,,	1 0*s.* 0*d.*
,,	½ to 2½	,,	24	,,	1 4*s.* 0*d.*
,,	2 to 3½	,,	36	,,	2 2*s.* 0*d.*

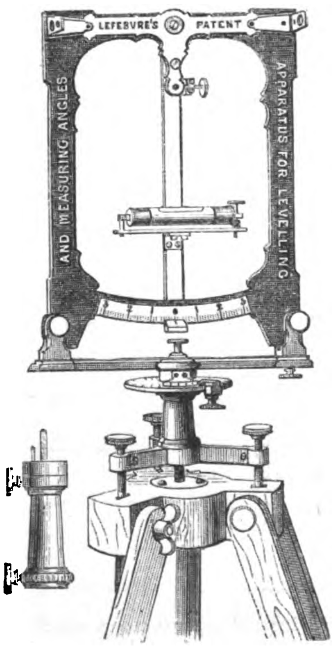
No. 4. **MAIDEN'S REGISTERED PIPE WRENCH.**
To take 1 inch tube 7*s* 6*d.* To take 1¼ inch tube 10*s.* 6*d.* To take 2½ inch tube 15*s.* 0*d.*



No. 5. COMBINED PIPE CUTTER AND WRENCH.

To take up to 1 inch. 18*s.* 6*d.*

Up to 2 inch, £1 10*s.*



LEFEBVRE'S PATENT CLYTHOGRAPH,

Or Apparatus for Levelling and Measuring Angles.

No. 1.	With malleable iron frame .	£2 0 0
,, 2.	,, brass frame	2 5 0
,, 3.	,, ,, and socket pillar for mounting on a stick	5 0 0

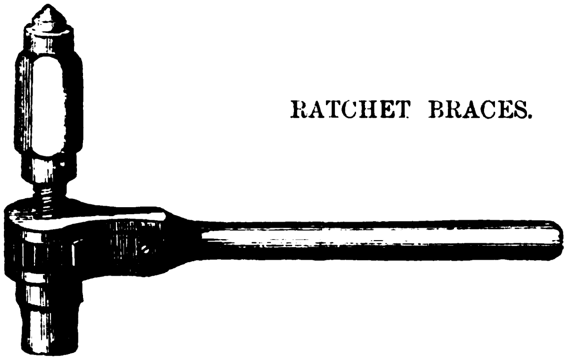
STEEL STRAIGHT EDGES, trued and accurately graduated, 10ths, 20ths, 50ths, 100ths; 12ths, 24ths, 48ths of an inch; and on the other side, 8ths, 16ths, 32ths, 64ths of an inch.

Lengths	6 in.	12 in.	24 in.	36 in.
Prices	7/6	13/6	27/6	47/6
Leather case extra	2/3	3/6	6/6	12/

If with bevelled Edges, *not* graduated,—

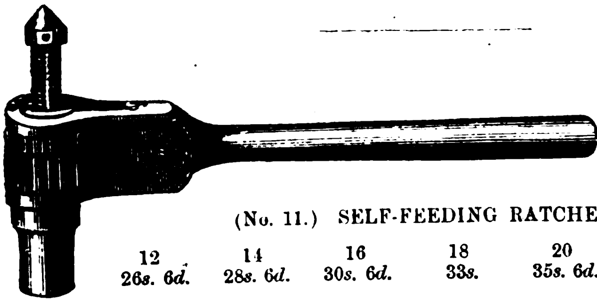
24 in. long ×	¼ in.	thick,	£2 0 0
36 ,,	¼	,,	£3 0 0

RATCHET BRACES.



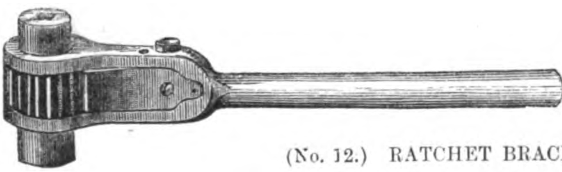
(No. 10.) STRONG WROUGHT IRON RATCHET BRACE. (Ordinary Pattern.)

12	14	16	18	20	22	24 inches.
16s.	18s.	19s. 6d.	21s.	22s. 6d.	24s.	26s. each.



(No. 11.) SELF-FEEDING RATCHET BRACE.

12	14	16	18	20	22	24 inches.
26s. 6d.	28s. 6d.	30s. 6d.	33s.	35s. 6d.	38s. 6d.	42s. 6d. each

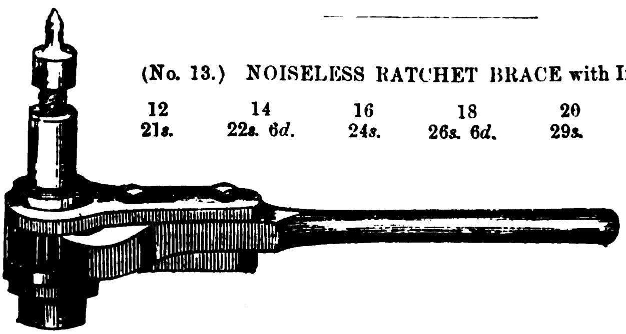


(No. 12.) RATCHET BRACE.

12	14	16	18	20	22	24 inches.
16s.	18s.	19s. 6d.	21s.	22s. 6d.	24s.	26s. each.

(No. 13.) NOISELESS RATCHET BRACE with Improved Eccentric Lever.

12	14	16	18	20	22	24 inches.
21s.	22s. 6d.	24s.	26s. 6d.	29s.	31s. 6d.	34s. each.

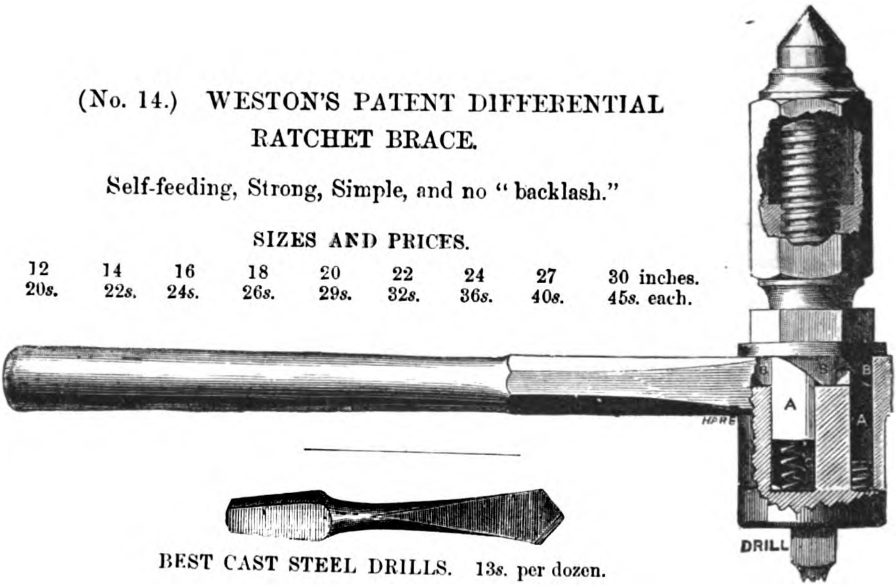


(No. 14.) WESTON'S PATENT DIFFERENTIAL RATCHET BRACE.

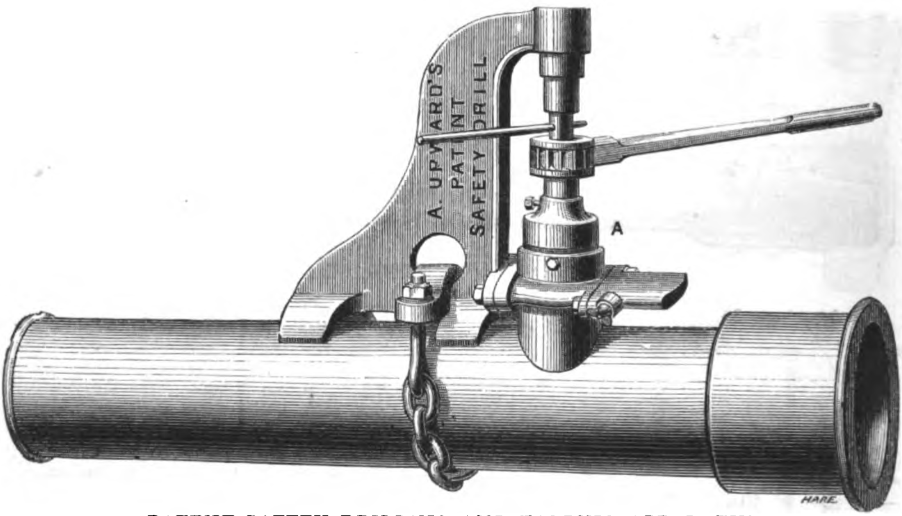
Self-feeding, Strong, Simple, and no "backlash."

SIZES AND PRICES.

12	14	16	18	20	22	24	27	30 inches.
20*s.*	22*s.*	24*s.*	26*s.*	29*s.*	32*s.*	36*s.*	40*s.*	45*s.* each.



BEST CAST STEEL DRILLS. 13*s.* per dozen.

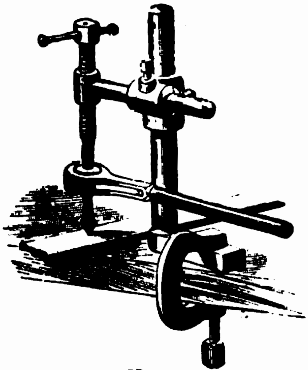


PATENT SAFETY DRILLING AND TAPPING APPARATUS,

For drilling and tapping gas mains without escape of gas, whilst connecting the service to the main, and without removing the Apparatus until both operations are completed.

Price, complete, with drills and taps, from ⅜ in. to 2 in. £20.

Instructions for use are sent with each Apparatus if required.



No. 1.

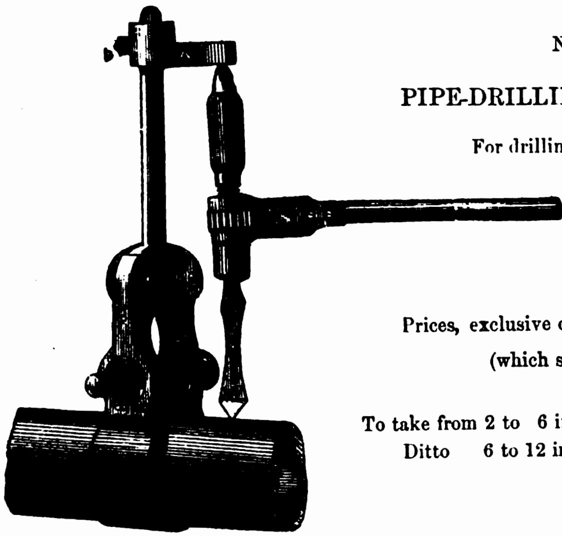
No. 1.

WROUGHT IRON DRILL CRAMP.

Very useful for repairs out of doors, with ratchet brace and one drill.

	1st size	2nd size	3rd size.
Height	15	18	21 in.
Diameter	1$\frac{5}{8}$	1$\frac{3}{4}$	1$\frac{7}{8}$,,
Length of arm . .	8	10	12 ,,
Length of ratchet .	14	16	18 ,,
Weight, about . .		30 lbs.	
Price	46/0	52/0	58/0

Drills up to 1$\frac{1}{4}$ inch diameter 8/6 per dozen.



No. 2.

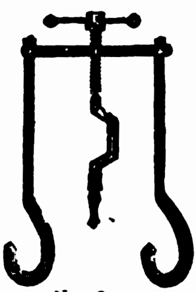
No. 2.

PIPE-DRILLING APPARATUS,

For drilling Main Pipes.

Prices, exclusive of ratchet brace or drills (which see pages 263 and 264).

	£	s.	d.
To take from 2 to 6 in. mains	4	4	0
Ditto 6 to 12 in. ,, ...	6	10	0



No. 3.

No. 3.

COMMON PIPE-DRILLING CRAMP AND BRACE.

	£.	s.	d.
Price	1	10	0

CHANGE WHEELS FOR SCREW CUTTING LATHES. (List No. 1.)

AND SUITABLE ALSO FOR ALL KINDS OF LIGHT MACHINERY.

THEY are cast from the most complete sets of Machine-cut Metal Patterns; and may be relied on as being perfectly true and symmetrical.

The teeth, formed on the principle of the epicycloidal curve, are perfect in their action; and being cast *without any taper*, the greatest possible amount of strength and durability is secured. The pitches are calculated on the Manchester principle.

LIST OF PRICES.

14 PITCH = $\frac{3}{16}$ in.

$\frac{5}{8}$ IN. WIDE ON FACE.

Suitable for 3 in. Centre Lathes.

No. of Teeth.				s.	d.
20	Plate Wheel	...	each	0	5
21	—	...	—	0	5
22	—	...	—	0	5
23	—	...	—	0	5
24	—	...	—	0	5
25	—	...	—	0	6½
30	—	...	—	0	6½
35	—	...	—	0	7½
40	—	...	—	0	7½
45	—	...	—	0	9
50	—	...	—	0	10
55	—	...	—	0	11½
60	—	...	—	1	1½
65	—	...	—	1	2½
70	—	...	—	1	3
75	—	...	—	1	4½
80	—	...	—	1	5½
85	—	...	—	1	7
90	—	...	—	1	8
95	—	...	—	1	10
100	—	...	—	1	11

The set complete, consisting of 22 wheels (including one 40-wheel extra), 16*s.*

If packed in case, 2*s.* extra.

12 PITCH = ¼ in.

$\frac{13}{16}$ IN. WIDE ON FACE.

Suitable for 4 in. or 5 in. Centre Lathes.

No. of Teeth.				s.	d.
20	Plate Wheel	...	each	0	6½
21	—	...	—	0	6½
22	—	...	—	0	6½
23	—	...	—	0	6½
24	—	...	—	0	6½
25	—	...	—	0	7½
30	—	...	—	0	7½
35	—	...	—	0	9
40	—	...	—	0	10
45	—	...	—	0	11½
50	—	...	—	1	0½
55	—	...	—	1	0½
60	—	...	—	1	1½
65	—	...	—	1	3
70	—	...	—	1	6
75	—	...	—	1	7
80	—	...	—	1	8
85	—	...	—	1	11
90	—	...	—	2	1
95	—	...	—	2	6
100	—	...	—	2	6

The set complete, consisting of 22 wheels (including one 40-wheel extra), 21*s.*

If packed in case, 2*s.* extra.

10 PITCH = $\frac{5}{16}$ in.

1 IN. WIDE ON FACE.

Suitable for 6 in. or 7 in. Centre Lathes.

No. of Teeth.				s.	d.
20	Plate Wheel	...	each	0	7½
25	—	...	—	0	7½
30	—	...	—	0	10
35	—	...	—	0	11½
40	—	...	—	1	0½
45	with Arms	...	—	1	1½
50	—	...	—	1	3
55	—	...	—	1	4½
60	—	...	—	1	6
65	—	...	—	1	7
70	—	...	—	1	10
75	—	...	—	1	11
80	—	...	—	2	1
85	—	...	—	2	3
90	—	...	—	2	4
95	—	...	—	2	6
100	—	...	—	2	9
105	—	...	—	2	11
110	—	...	—	3	2
115	—	...	—	3	4
120	—	...	—	3	9

The set complete, consisting of 22 wheels (including one wheel extra), £1 14*s.*

If packed in case, 2*s.* 6*d.* extra.

8 PITCH = ⅜ in.

1¼ IN. WIDE ON FACE.

Suitable for 8 in. to 10 in. Centre Lathes.

No. of Teeth.				s.	d.
20	Plate Wheel	...	each	0	7½
25	—	...	—	0	11½
30	—	...	—	1	3
35	—	...	—	1	7
40	—	...	—	1	11
45	—	...	—	2	1
50	with Arms	...	—	2	4
55	—	...	—	2	6
60	—	...	—	2	9
65	—	...	—	2	11
70	—	...	—	3	2
75	—	...	—	3	4
80	—	...	—	3	7
85	—	...	—	3	9
90	—	...	—	4	1
95	—	...	—	4	5
100	—	...	—	4	9
105	—	...	—	5	0
110	—	...	—	5	4
115	—	...	—	5	8
120	—	...	—	6	0

The set complete, consisting of 22 wheels (including one 60-wheel extra), £2 12*s.* 6*d.*

If packed in case, 4*s.* 6*d.* extra.

7 PITCH = $\frac{7}{16}$ full.

1½ IN. WIDE ON FACE.

Suitable for 12 in. to 15 in. Centre Lathes.

No. of Teeth.				s.	d.
20	Plate Wheel	...	each	0	11½
25	—	...	—	1	6
30	—	...	—	2	1
35	—	...	—	2	4
40	—	...	—	2	6
45	—	...	—	2	10
50	with Arms	...	—	3	2
55	—	...	—	3	6
60	—	...	—	3	9
65	—	...	—	4	1
70	—	...	—	4	5
75	—	...	—	4	10
80	—	...	—	5	4
85	—	...	—	5	8
90	—	...	—	6	0
95	—	...	—	6	[illegible]
100	—	...	—	6	8
105	—	...	—	7	1
110	—	...	—	7	6
115	—	...	—	8	3
120	—	...	—	8	9

The set complete, consisting of 22 wheels (including one 60-wheel extra), £4 2*s.*

If packed in case, 6*s.* extra.

For other sizes of the above Pitches, see List No. 2.

CHANGE WHEEL LIST. (No. 2.)

14 PITCH.

Teeth	s.	d.
15 Teeth	0	5
16 —	0	5
17 —	0	5
18 —	0	5
19 —	0	5
26 —	0	6½
27 —	0	6½
28 —	0	6½
29 —	0	6½
31 —	0	7½
32 —	0	7½
33 —	0	7½
34 —	0	7½
36 —	0	7½
37 —	0	7½
38 —	0	7½
39 —	0	7½
42 —	0	9
44 —	0	9
46 —	0	10
48 —	0	10
52 —	0	11½
54 —	0	11½
56 —	1	0½
58 —	1	0½
110 —	2	3
120 —	2	6
130 —	2	10
140 —	3	2
150 —	3	9

12 PITCH.

Teeth	s.	d.
15 Teeth	0	6½
16 —	0	6½
17 —	0	6½
18 —	0	6½
19 —	0	6½
26 —	0	7½
27 —	0	7½
28 —	0	7½
29 —	0	7½
31 —	0	9
32 —	0	9
33 —	0	9
34 —	0	9
36 —	0	10
37 —	0	10
38 —	0	10
39 —	0	10
42 —	0	11½
44 —	0	11½
46 —	1	0½
48 —	1	0½
52 —	1	0½
54 —	1	0½
56 —	1	2
58 —	1	2
105 —	2	6
110 —	2	10
120 —	3	2
130 —	3	9

12 PITCH—*continued.*

Teeth	s.	d.
140 Teeth	4	4½
150 —	5	0

10 PITCH.

Teeth	s.	d.
15 —	0	7½
16 —	0	7½
17 —	0	7½
18 —	0	7½
19 —	0	7½
21 —	0	7½
22 —	0	7½
23 —	0	7½
24 —	0	7½
26 —	0	10
28 —	0	10
130 —	4	6
140 —	5	0
150 —	5	9
160 —	6	3

8 PITCH.

Teeth	s.	d.
15 —	0	7½
16 —	0	7½
17 —	0	7½
18 —	0	7½
19 —	0	7½
21 —	0	10
22 —	0	10
23 —	0	11½
24 —	0	11½
26 —	1	0½

8 PITCH—*continued.*

Teeth	s.	d.
28 Teeth	1	2
32 —	1	3
34 —	1	6
36 —	1	8
38 —	1	11
42 —	2	1
44 —	2	1
46 —	2	3
48 —	2	4
52 —	2	6
54 —	2	6
56 —	2	9
58 —	2	9
62 —	2	10
64 —	2	11
66 —	2	11
68 —	3	2
72 —	3	2
74 —	3	4
76 —	3	6
78 —	3	6
130 —	6	3
140 —	6	9
150 —	7	3
174 —	17	6
200 —	22	0

7 PITCH.

Teeth	s.	d.
16 Teeth	0	11½
88 —	5	10

Sets of the foregoing, of any desired series, at proportionately reduced prices.

MITRE WHEELS.

Pitch.	No. of Pattern.	Price per Pair.	No. of Teeth.	Width on Face.	Boss. Diameter.	Boss. Length.
		s. d.		inches.	inches.	inches.
12 PITCH	21	1 3	18	½	¾	½
10 PITCH	25	1 3	20	⅝	1	⅝
	26	1 3	25	¾	1	¾
	27	1 7	30	⅞	1¼	1
8 PITCH	31	1 11	24	1	1¼	1
	32	2 6	28	1⅛	1⅜	1
	33	3 2	32	1¼	1½	1
7 PITCH	40	2 6	20	1	1¼	1
	41	3 2	26	1	1½	1
	42	3 9	32	1	2	1¼
	43	4 6	35	1⅛	2¼	1¼
	44	5 0	42	1¼	2½	1½

BEVIL WHEELS.

Pitch.	No. of Pattern.	Price per Pair.	No. of Teeth. Pinion.	No. of Teeth. Wheel.	Width on Face.	Diameter of Boss. Pinion.	Diameter of Boss. Wheel.	Length of Boss. Pinion.	Length of Boss. Wheel.
		s. d.			inches.	inches.	inches.	inches.	inches.
12 PITCH	73	1 3	20	30	½	¾	1	½	⅝
	74	1 3	16	32	½	¾	1	½	⅝
	75	1 3	14	42	½	¾	1¼	½	¾
	76	1 3	18	45	½	¾	1¼	½	¾
10 PITCH	81	1 3	14	28	⅝	¾	1¼	⅝	¾
	82	1 7	20	30	⅝	⅞	1¼	⅝	¾
	83	1 11	16	40	¾	⅞	1¼	⅝	⅞
	84	3 3	18	54	⅞	⅞	2	⅝	1
	85	2 6	22	44	1	⅞	1¾	⅝	1
6 PITCH	91	3 9	24	48	1¼	1¼	2¼	¾	1¼

Any of the foregoing can be made without Bosses, or with Bosses of any required size to order.

GEAR WHEELS FOR HEADSTOCKS,

And other Wheels of coarser pitch than those enumerated can also be had on application.

TO FIND THE DIAMETER OF ANY WHEEL IN THIS LIST:

Divide the number of teeth by the pitch, and the quotient is the exact diameter in inches at the pitch line, thus:

A Wheel 8 pitch, 95 teeth, will be $\frac{95}{8}$ = 11⅞ diameter at pitch line.

Ditto, 12 pitch, 54 teeth, will be $\frac{54}{12}$ = 4½ diameter at pitch line

PRICE LIST OF PULLEYS AND DRUMS.

All turned on the face and edges, and bored.

Diameter in Inches.	Inches Broad.								
	4	5	6	7	8	9	10	11	12
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
10	0 9 9	0 11 9	0 13 6	0 15 3	0 16 6	0 17 8	1 0 0	1 1 9	1 3 6
11	0 10 10	0 12 9	0 14 9	0 16 9	0 18 3	0 19 5	1 2 0	1 3 9	1 5 10
12	0 12 3	0 13 9	0 16 2	0 18 3	1 0 0	1 2 4	1 4 0	1 5 10	1 8 3
13	0 13 3	0 14 9	0 17 4	0 19 9	1 1 9	1 4 0	1 6 2	1 8 3	1 10 6
14	0 14 2	0 15 10	0 18 6	1 1 2	1 3 6	1 5 10	1 8 3	1 11 3	1 13 0
15	0 15 3	0 17 0	1 0 0	1 2 9	1 5 3	1 7 8	1 10 6	1 13 0	1 15 3
16	0 16 6	0 18 6	1 1 9	1 4 0	1 7 0	1 9 4	1 12 4	1 15 3	1 17 8
17	0 17 0	0 19 6	1 2 9	1 5 6	1 8 9	1 11 3	1 14 8	1 17 8	2 0 0
18	0 18 0	1 0 6	1 3 9	1 7 0	1 10 6	1 13 0	1 16 6	2 0 0	2 2 4
19	0 18 9	1 1 6	1 5 0	1 8 6	1 12 4	1 14 8	1 18 3	2 2 4	2 4 9
20	0 19 9	1 2 4	1 7 0	1 10 6	1 14 3	1 17 0	2 0 6	2 4 0	2 7 0
21	1 0 6	1 3 3	1 8 3	1 12 0	1 15 10	1 18 9	2 3 0	2 6 6	2 9 6
22	1 1 9	1 4 3	1 9 6	1 13 6	1 17 9	2 0 6	2 5 3	2 8 9	2 11 9
23	1 3 0	1 6 6	1 10 10	1 15 0	1 19 6	2 2 3	2 7 9	2 11 3	2 14 0
24	1 4 0	1 7 4	1 12 4	1 16 6	2 1 0	2 4 0	2 10 0	2 13 6	2 16 6
25	1 5 3	1 8 6	1 13 9	1 18 3	2 3 0	2 6 6	2 11 3	2 15 3	2 18 9
26	1 6 3	1 9 9	1 15 3	1 19 9	2 4 9	2 8 3	2 13 0	2 17 6	3 1 3
27	1 7 4	1 10 10	1 16 6	2 1 3	2 6 6	2 10 0	2 15 3	2 19 6	3 3 6
28	1 8 9	1 12 0	1 17 9	2 2 9	2 8 3	2 11 9	2 17 6	3 1 3	3 5 9
29	1 10 0	1 13 3	1 18 9	2 4 0	2 10 0	2 13 6	3 0 0	3 3 6	3 8 3
30	1 11 3	1 14 0	2 0 6	2 5 9	2 11 9	2 16 0	3 1 9	3 5 9	3 10 6
32	1 13 0	1 16 6	2 3 0	2 8 9	2 14 9	2 19 6	3 4 9	3 10 6	3 15 3
34	1 15 3	1 18 9	2 5 3	2 11 9	2 17 6	3 3 0	3 8 3	3 15 3	4 0 0
36	1 17 6	2 1 0	2 8 3	2 14 9	3 1 8	3 6 6	3 12 6	4 0 0	4 6 9
38	1 19 6	2 3 6	2 10 6	2 17 6	3 4 9	3 10 0	3 16 0	4 4 9	4 9 6
40	2 1 0	2 5 9	2 14 0	3 1 0	3 7 9	3 14 3	4 1 3	4 8 3	4 14 3
42	2 3 0	2 8 6	2 16 9	3 3 9	3 10 0	3 17 6	4 6 0	4 13 0	4 18 9
44	2 5 3	2 12 0	2 18 3	3 6 9	3 13 6	4 1 3	4 10 9	4 17 9	5 3 6
46	2 7 0	2 14 9	3 2 6	3 9 9	3 17 0	4 5 3	4 14 9	5 1 3	5 8 3
48	2 9 3	2 16 6	3 5 3	3 12 9	3 19 6	4 8 3	4 17 3	5 6 0	5 13 0
54	2 14 9	3 1 9	3 13 0	4 2 6	4 13 0	5 0 0	5 10 6	5 17 9	6 7 0
60	3 1 9	3 9 6	4 1 3	4 18 9	5 1 6	5 11 9	6 1 9	6 11 9	7 1 3
72	4 2 6	4 14 3	5 11 9	6 3 6	6 15 6	7 7 0	7 19 0	8 10 6	9 2 6

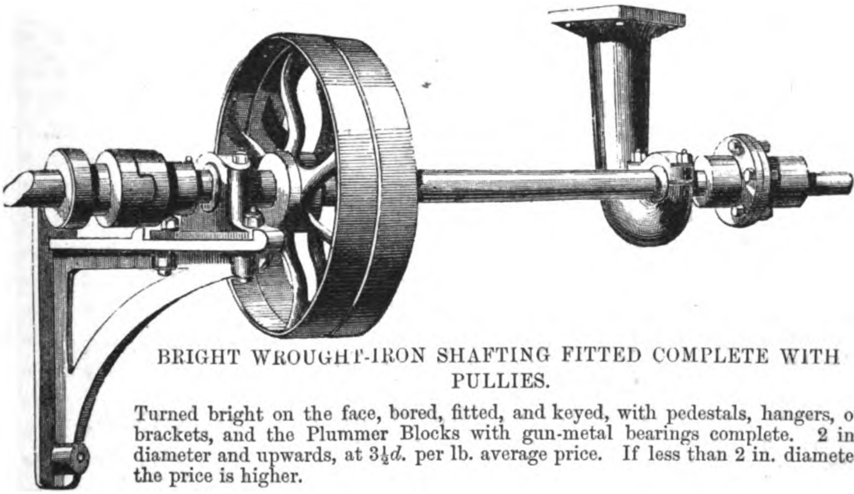
NOTE.—Split Pulleys are charged one sixth more than above. All turned holes above 3 inches diameter are charged, for every inch above that size, extra.

Keyway cutting 2/6 to 3/6 extra.

If "Split Pulleys" are required it should be distinctly stated.

PATENT WROUGHT IRON SPLIT PULLEYS, DRUMS, CONES, AND GLAZIERS.

THESE Drums, &c. are only half the weight of the cast iron ones, whilst they are much stronger and more evenly balanced; they do not require keying on, the belts are not liable to slip, do not get heated, wear longer, and can be run slacker; there is no liability to breakage; they are invaluable for high speeds, can be made any required size either in diameter, width on face, or size of hole, and the price is *about* the same as the cast iron ones (see price list on preceding page) which may be taken as approximately correct The prices of SOLID WROUGHT IRON DRUMS will also be about the same as solid cast iron ones.



BRIGHT WROUGHT-IRON SHAFTING FITTED COMPLETE WITH PULLIES.

Turned bright on the face, bored, fitted, and keyed, with pedestals, hangers, or brackets, and the Plummer Blocks with gun-metal bearings complete. 2 in. diameter and upwards, at 3½*d.* per lb. average price. If less than 2 in. diameter the price is higher.

	1¾	2	2¼	2½	2¾	3 in. diam.
Plain Shafting with Collars, Bright. .	4/6	5/6	7/0	8/0	9/0	10/6 per ft.
„ Black. .	2/6	3/0	4/0	5/0	5/6	6/6 „

CAST-IRON PEDESTALS OR PLUMMER BLOCKS,

With Gun-metal bearings, fitted and bored complete.

To suit Shafting	1¾	2	2¼	2½	2¾	3 in. diam.
Strong Patterns.	12/6	16/0	27/6	32/6	39/0	54/0 each.
Lighter Patterns	—	—	22/6	28/6	34/0	42/0 „

PEDESTALS of larger sizes are made to order.

BRACKETS to support Plummer Blocks. HANGERS fitted with brasses. FLANGED COUPLINGS. CLUTCH BOXES. LOOSE COLLARS. PULLIES, fast and loose, all sizes (see page 268).

PATENT SELF-OILING PEDESTALS.

These Pedestals are made to contain a supply of oil sufficient to last for two to three weeks, which much reduces the friction, trouble, and expense of working.

To suit Shafting	1¾	2	2¼	2½	2¾	3 in. diam.
Pedestals with one step, each .	17/0	19/6	23/0	25/6	31/0	40/0
Ditto with two steps, each.	20/0	24/0	28/0	34/0	40/0	50/0

DRIVING BANDS, BEST LEATHER.

Width:	2	2½	3	4	5	6	7	8	9	10	11	12 in.	
	d.	*d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	
Best Single Bands	8	10	1 2	1 8	2 0	2 5	2 10	3 6					per ft.
,, Double ,,			2 4	3 3	4 0	4 9	5 9	6 10	7 6	8 8		10 2	,,
,, Edge ,,			2 1	2 11	3 5	3 10	4 5	4 11					,,
,, Patent Double			2 3	3 2	4 0	4 7	5 8	6 8	7 6	8 7	9 6	10 6	,,

Best Laces, 2*s.* to 6*s.* per doz. according to size.

ROUND LEATHER BANDS.

Diameter:	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1 in.
Per foot:	7*d.*	10*d.*	1*s.* 1*d.*	1*s.* 5*d.*	1*s.* 9*d.*	2*s.* 5*d.*

BEST GUT WHEEL BANDS.

Diameter:	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1 in.
Per foot:	4½*d.*	10*d.*	1*s.* 5*d.*	2*s.*	2*s.* 6*d.*	3*s.* 9*d.*	5*s.*

HOOKS AND EYES FOR ROUND BANDS.

Diameter:	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1 in.
Per pair:	1*s.* 2*d.*	2*s.*	3*s.*	4*s.* 6*d.*	6*s.* 2*d.*	7*s.* 9*d.*

MILL BAND SCREWS.

No.	1	2	3	4	5	6	7	8
Per doz:	2*s.* 6*d.*	2*s.* 9*d.*	3*s.* 1*d.*	3*s.* 4*d.*	3*s.* 8*d.*	4*s.*	4*s.* 3*d.*	4*s* 6.

DRIVING BANDS, INDIA RUBBER AND COTTON CANVAS.

Width:	2	2½	3	4	5	6	7	8	9	10	11	12 inches	
Ply.	*s. d.*	*s. d*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	
2	0 6	0 7½	0 9	1 0	1 2½	1 6	1 9	2 0	2 3	2 6	2 10	3 2	per ft.
3	0 8	0 10	0 10	1 4	1 8	2 0	2 4	2 8	3 0	3 4	3 9	4 3	,,
4	0 11	1 1	1 3½	1 8	2 0	2 5	2 11	3 6	4 0	4 6	5 0	5 6	,,
5	1 2	1 4	1 7	2 1	2 7	3 1	3 10	4 4	4 11	5 6	6 2	6 10	,,
6	1 5	1 8	2 0	2 6	3 0	3 8	4 5	5 1	5 10	6 7	7 5	8 3	,,

STEAM PACKING.

		s.	*d.*	
INDIA RUBBER AND CANVAS in sheets, six yards long . . .	A. quality at	1	3	per lb.
ROPE, round or square for pistons	,, ,,	1	4½	,,
Do. Vulcanized Rubber core in centre	B. ,,	1	9	,,
Ditto ditto very elastic	C. ,,	2	3	,,
HIGH PRESSURE PACKING	D. ,,	2	6	,,
Ditto	E. ,,	3	6	,,
WASHERS or RINGS	A. ,,	1	6	,,
Ditto, or ditto cut from sheet		2	6	,,
Ditto, or ditto cut from tube		2	0	,,
METALLIC ELASTIC PACKING for Piston Rods, Steam Hammers, Glands, Plunger Pumps, &c.		2	3	,,

SOLID INDIA RUBBER ROPE OR CORD.

Second Quality, 4*s.* to 5*s.* 9*d.* per lb. according to size; Best Quality 6*s.* to 8*s.* per lb. according to size.

GAUGE GLASS RINGS (see page 296).

VALVES FOR MARINE AND LAND ENGINES.

Second Quality, 3*s.* 2*d.* Best, 3*s.* 6*d.* per lb. PATENT INDIA RUBBER VALVES, 3*s.* 9*d.* per lb.

BUFFERS, SPRINGS, WHEEL TYRES, &c., 1*s.* 6*d.* to 4*s.* 3*d.* per lb.

The special use required should in all cases be stated.

BLOWING AND EXHAUSTING FANS.

THE Fan is perfectly noiseless in its action, and may be used either for blowing smiths' fires, furnaces, &c; or for exhausting the air and gases from mines, ships' holds, sewers, wells, &c.

It consists of a central boss, having curved radial arms carrying the blades, which are of metal plates and taper towards their circumference. To the side edges of the blades are bolted two circular conical plates equal to them in diameter, thus forming a circular air-tight disc, divided into compartments by the blades, and having a circular hole in the centre through which the air is drawn in. This is keyed on a central shaft, which revolves in long brass bearings and carries a driving pulley on its end.

The whole is enclosed in a Cast Iron Case, in which are the bearings for the shaft, and an inlet, and an outlet can be made at any desired part of the circumference, to either of which the pipes may be connected as it is required for blowing or exhausting purposes.

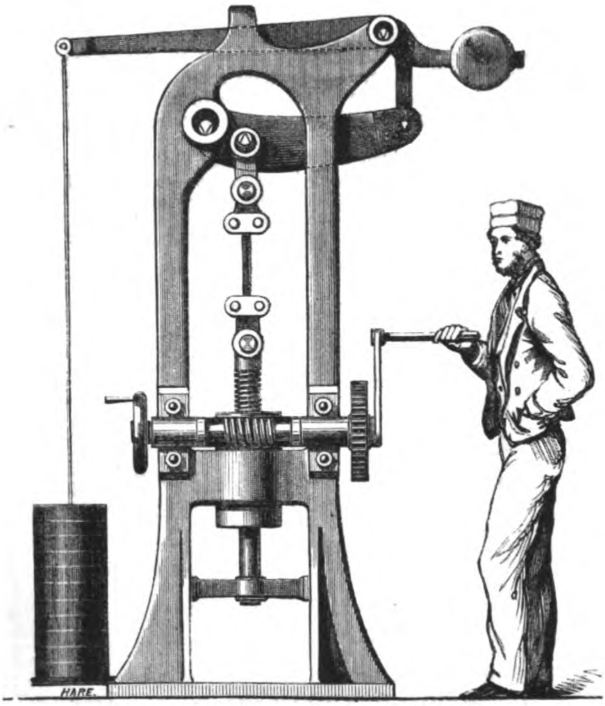
1	2	3	4	5	6	7	8	9
Diameter of disc.	Horse power required.	Number of Revolutions per minute.	Number of Smiths' fires.	Cwts. Metal melted per hour.	Diameter of pulley.	Breadth of Driving Band.	Diameter of discharge pipe.	Nett Price.
Inches.					Inches.	Inches.	Inches.	£ s. d.
13	½	1800 to 2000	4	6	4	1½	5 round	5 0 0
16	¾	1700 ,, 1900	6	10	5	2	6 ,,	7 0 0
19	1¼	1600 ,, 1800	9	15	6	2½	8 ,,	9 10 0
22	2	1500 ,, 1700	12	22	7	3	9 ,,	13 0 0
25	2½	1400 ,, 1600	16	30	8	3½	10 ,,	17 0 0
30	3	1300 ,, 1500	25	45	9	4	12 ,,	22 0 0
36	4	1200 ,, 1400	40	60	11	4½	14 square	28 0 0
42	5½	1000 ,, 1200	60	90	13	5	17 ,,	34 0 0
48	7	800 ,, 1000	90	120	15	5½	20 ,,	40 0 0

A smaller size than any of the above, to work by hand, is made complete on frame; it requires no fixing, and is capable of passing 20,000 cubic feet per hour . . . Price £9.

NOTES IN EXPLANATION OF TABLE.

1. The diameter of revolving disc. The outside cases are about one-sixth larger.
2. The greatest power required at the speeds indicated.
3. The highest speeds given will be the best for the maximum work and long distances. For the minimum work and short distances, the lowest speed will give the proper pressure.
4. In the number of smiths' fires given, the tuyere irons are calculated at 1¼ in. diameter. Allowance must be made for larger sizes.
5. The quantity of iron melted will of course vary with the size and height of cupola, size of blast pipe &c., but the quantity named will be found about the average.
6. The pulleys named are the best sizes, but they may be varied one inch either way to suit gearing already in use. The Fan spindle may be made to take pulley on either side to order.
7. The driving bands should be single and very flexible with the joints as neat as possible.
8. The discharge pipe of Fans up to 30 in. diameter are round. The largest sizes have square discharge pipes, and also a horizontal joint across centre to facilitate repairs, without disturbing the lower part of Fan. The main pipe should not be of less size than the discharge pipe of Fan.
9. The nett prices of the Blowers and also of the Exhausters. When combined, the prices are 25 per cent higher than the above.

PATENT TESTING MACHINES, FOR ASCERTAINING THE TENSILE AND TRANSVERSE STRENGTH OF METALS.



THESE Testing Machines are made on the principle required by the Board of Trade, for testing chains and anchors, namely, that of showing the strain applied by a system of levers and dead weights. The article under test is secured between the two jaws or clamps, and the power is exerted at the lower end of the test bar by the screw and worm wheel, and the levers above show the strain applied; all the levers are hung on hardened steel knife edged centres.

The combined leverage obtained is about 560 to 1; thus, a weight of 1 lb. at the end of the lever is equal to a strain of 5 cwt. on the article, and this may be increased *ad infinitum.* A special arrangement is required for transverse strains.

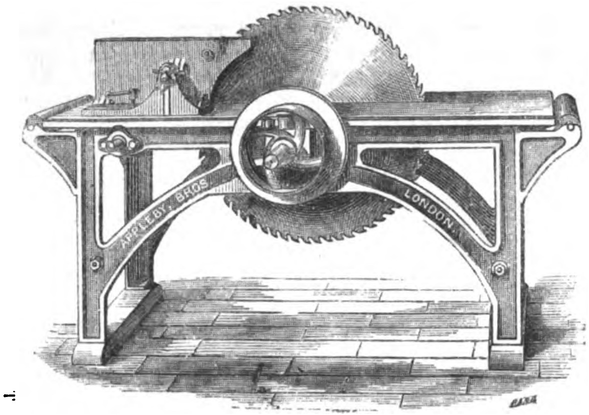
FOR TENSILE STRAINS.

1.—Machine for Steel and Bar Iron, up to 30 tons,	£90.	Weight about 50 cwt.
2.—Ditto, for Steel, Iron, or Brass, up to 10 tons .	£60.	„ 25 „
3.—Ditto, for Wire Rope up to 5 tons	£42.	„ 25 „
4.—Ditto, for Wire or Brass, up to 2 tons . . .	£35.	„ 15 „

FOR TRANSVERSE STRAINS.

Machine for Cast Iron Bars, 2 × 1 in., and 3 ft. bearings	£21 10s.	„ 10 „

CIRCULAR SAW BENCH. (No. 1.)



THE table is planed and is bolted to the strong cast-iron frame; the saw is fixed on a steel spindle, working in long conical gun-metal bearings, with the driving pulley on one end; a parallel fence with adjustable motions is provided, and a sliding plate to adapt it to saws of different diameters. The larger sizes have wrought-iron rollers at the ends (as shown).

These benches can also be fitted with the saw spindle to rise and fall, and where several kinds of work are required this will be found a valuable addition, as the bench can then be used for all the purposes to which an ordinary circular saw bench can be applied, as well as for grooving timber to any depth within the compass of the saw. Cutter blocks may also be fitted to the saw spindle, for making mouldings up to 2½ inches wide, at a cost of £5 for the block and one set of cutters. The table is provided with a pressure roller and lever, which, by means of a rope and weight, keeps the wood up to the fence whilst under the action of the saw or cutter.

Size of Table.	With Saw.	Will take in a Saw.	Price.	Price of Loose Pulley and Strap Lever, extra.	Diagonal Motion to Fence, extra.	Boring Apparatus and four Bits, extra.	Boring Table, extra.	Packing for Shipment.	Approximate Weight.	Diameter of Driving Pulley.	Number of Revolutions per minute.	Power required about	Price, with Rising and Falling Saw Spindle.
	Inch. diam.	Inch. diam.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	Cwt.	Inch.	Revs.		£ s. d.
4′ 0″ × 2′ 0″	24	24	16 10 0	1 15 0	13 0	1 15 0	2 18 6	0 12 6	6	12	1,200	4 H.P.	30 0 0
5′ 0″ × 2′ 6″	30	36	22 10 0	2 1 0	17 6	1 15 0	3 10 0	0 17 6	9	14	1,000	5 ,,	35 0 0
6′ 0″ × 2′ 8″	36	42	33 0 0	2 7 0	17 6	1 15 0	4 0 0	1 6 6	18	16	800	6 ,,	60 0 0

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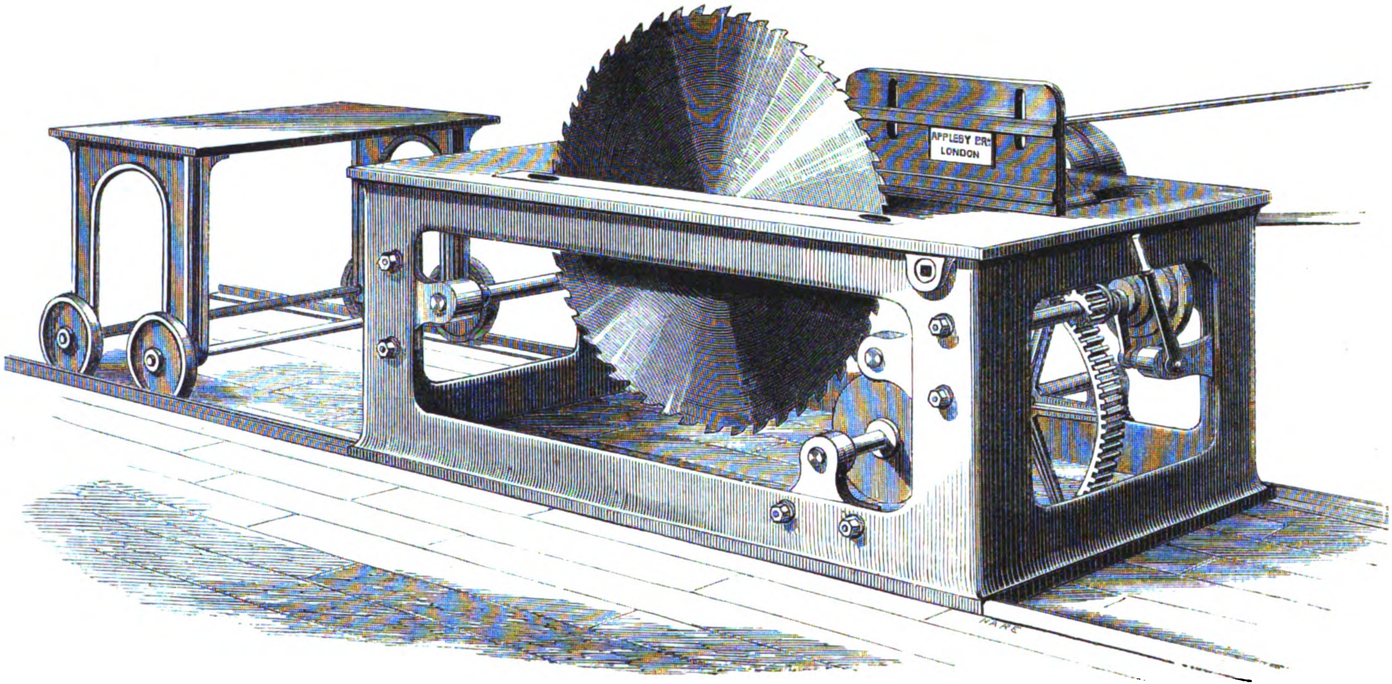


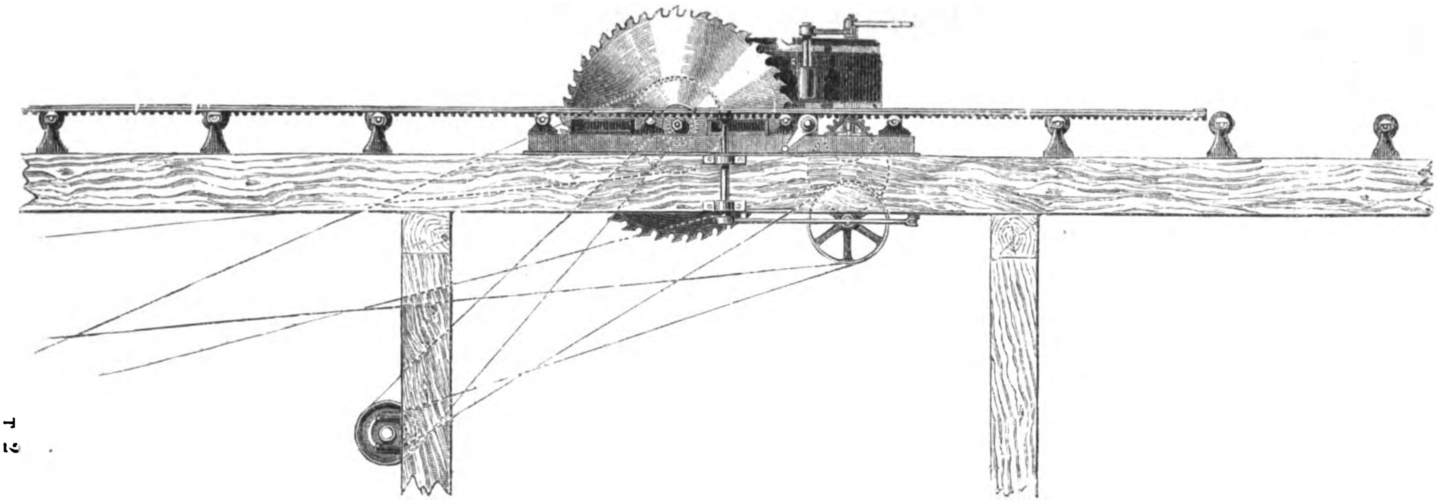
APPLEBY'S IMPROVED SELF-ACTING CIRCULAR SAW BENCH. (No. 2).

WITH planed cast-iron table fitted on a strong solid metal frame, and being cast in one piece it is perfectly rigid, and so massive that no foundation is required, with Circular Saw, and provided with variable self-acting silent feed motion, which draws up the timber to the saw, parallel fence with diagonal motion, fast and loose pulleys, and throwing-out gear.

Table, 6 ft. 6 in. × 3 ft. 2 in.	with 48 in. best cast steel circular saw, price, with pulley	16 in. diam.	£68.	Power required about	8 H.P., revols.	800 per min.
" "	42 in. " " " "	16 "	£65.	" "	7 " "	900 "
Table, 6 ft. × 2 ft. 8 in.	with 36 in. " " " "	14 "	£54.	" "	6 " "	1,000 "

A set of Rails and Carriage wheels, for supporting long timber to and from saw, extra £14.

These are strong and excellent Benches for Contractors and Builders.



IMPROVED RACK SAW BENCH. (No. 3.)

For breaking down heavy logs of timber into scantling, or for work in woods or forests, where the timber frame is usually made on the spot. The timber is carried to the saw upon an iron travelling bed, running upon turned iron rollers, at speeds varying from 12 to 45 feet per minute, according to the nature of the work, and with a quick return motion of about 70 feet per minute. A number of cast-iron rollers, revolving in iron carriages, are provided for fixing alongside the travelling bed, to facilitate the getting heavy timber on and off the bench.

The Prices are :—

	£	s.	d.	
For a Bench No. 1, with 48-inch saw (but will admit a 60-inch saw), wrought-iron bed 30 feet long, in 2 widths of 18 and 6 inches, and a set of rollers and carriages, as shown, with pulley 20 inches diameter . .	£160	0	0	Power required about 6 H. P., revolutions 700 per minute.
For Wood Frame 60 ft. long, for fixing the bench and roll carriages upon, and carrying the guide and timber rolls	25	0	0	
For Bench No. 2, with 60-inch saw, wrought-iron bed 45 ft. long, in 2 widths of 24 and 18 inches, and set of rollers and carriages, driving pulley 24 inches diameter	200	0	0	Ditto ditto 8 H. P., ditto 600 ditto.
For Wood Frame as above described, except 90 ft. long	45	0	0	

When for Exportation, the particulars for making the Wood Frame are furnished if required.

SLEEPER SAW BENCH.

This machine is expressly adapted for converting round timber into sleepers where only one cut is required in each piece; it can, however, be used as an ordinary saw bench when not required for cutting sleepers. The timber is brought up by an endless chain, fitted with wrought-iron dogs, which catch hold of the end of the piece and carry it past the saw in a perfectly straight line. This bench will take a saw 48 in. diameter, and will split about four sleepers per minute.

Price.	Weight.	H. P. required.	Diam. of Pulley.	Speed of Saw.
£125 0 0	2 tons.	8 horse.	18 inches.	800 revs.

CROSS-CUT SAWS.

The smaller benches differ but slightly from an ordinary saw bench, excepting that the saw is placed *across* the bench instead of in the usual direction, and the table is fitted with a planed slide provided with a fence for holding the timber to be cross-cut; this slide is carried by friction rollers, upon which it moves very easily, and is of sufficient size to take a plank 18 inches wide by 6 inches thick.

It is a very useful tool for cross-cutting planks, deals, scantling, panels, &c. and from the perfect manner in which the sliding table is adjusted to the saw, and the high speed of the saw, the cuts are perfectly square, true, and smooth.

Price.	Weight.	H. P. required.	Diam. of driving Pulleys.	Speed of Saw.
£34 10 0	8 cwt.	1 horse.	5 inches.	2000 revs.

SELF-ACTING CROSS-CUT SAW.

This tool is proportioned for heavier work than that last described, and is fitted with a self-acting movement for raising and lowering the saw and saw spindle; therefore, when the cut is being made the timber is at rest, and the saw is fed up to it.

This is accomplished by the saw being fixed to the upper end of a radial arm, having its fulcrum below the floor line, and on the same centre as the counter-shaft, thus making the length of the driving strap always constant, whatever the position of saw; and after a cut has been made, the saw returns to its original position without any attention.

Price.	Approximate Weight.	H.P. required.	Diam. of driving Pulleys.	Speed of Shaft.
£63 0 0	18 cwt.	2 horse.	12 inches.	300 revs.

VENEER CUTTING SAWS.

These machines are made of three sizes for saws, 8 feet, 10 feet, and 14 feet diameter, and are complete with travelling frame and all the necessary dividing and feeding apparatus, including pulleys on the machine for driving, and one complete set of saw segments fitted on, together with all holding down bolts, screws, and slides complete.

8 feet diameter saw	£160 0 0
10 feet ,, ,, ...	210 0 0
14 feet ,, ,, ...	340 0 0

For prices of circular saws, see page 400.

RECIPROCATING SAWS.

TIMBER AND DEAL FRAMES may be divided into the following classes, viz. :—

1st. Those driven from below.
2d. Those driven from above.
3d. Those where the feed motion is obtained by fluted rollers; and
4th. Those where the timber is laid on a travelling frame, and brought up to the saws by a chain or rack gear.

Each arrangement has its advantages; the first mentioned, that driven from below, is the best, where a basement floor can be easily obtained, as all revolving parts and straps, &c. are effectually protected, and the sawdust falls below as made.

The second, where the driving gear is above, is more easily fixed, and is convenient in many situations where surface water, drainage, and other causes are against the use of the pit below.

The third kind, with the feed rollers, works well when the timber is roughly hewn, and when the deals are good and moderately dry, but in sawing logs of very varying form the nipping screw roller requires constant attention.

In frames of the last-named construction, where the timbers or deals are secured to a travelling frame, when once fixed and started, but little attention is required except to remove the transomes and dogs as they come up to the saws. With the roller feed there is no loss of time caused by running back the rack or travelling frame, for as soon as one deal is through the rollers, another is put in; the loss of time incurred with rack or traveller is materially reduced by the quick return motion which is worked from the crank shaft of the machine, and is similar to that used in the No. 3 Rack Saw Bench.

Any of the machines can be made to drive *direct* from an engine attached to the main framing, which in many cases is more convenient and economical than conveying the power some distance by means of shafting with the necessary bearings, gear, straps, &c.

All these machines are fitted with the patent silent feed, which is easily adjusted to any speed of cut when the machine is in motion.

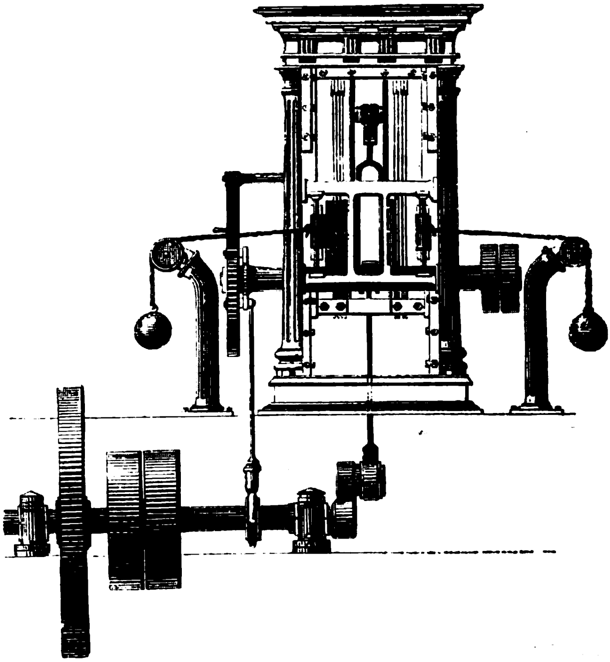
TIMBER FRAME WITH ROLLER FEED.

EACH machine is supplied with two strong cast-iron carriages, with screw dogs for holding the timber, and one of them is fitted with a transverse screw for use when cutting bent timber; the swinging frame is entirely of wrought-iron, and the whole is complete, with all ironwork, holding down bolts and iron rails for the carriages to run upon; but the subjoined prices do not include saws, buckles, steel keys, and driving straps.

Size.	Price of Frame driven from above.	Price of Frame driven from below.	With Traveller driven from above or below.	Weight about	Length of Travel.	Number of Saws Frame will carry.	Diameter of Driving Pulley.	Revolutions of Crankshaft per minute.	Power required about	Deal Cutting Apparatus, extra.
20 in.	£200	£220	£250	6¼ tons.	25 ft.	20	36 in.	160	6 H.P.	£15
24 ,,	240	250	280	9 ,,	30 ,,	24	42 ,,	140	8 ,,	20
30 ,,	280	295	320	10¼ ,,	35 ,,	30	48 ,,	130	10 ,,	25
36 ,,	310	320	3[illegible]5	12 ,,	35 ,,	36	48 ,,	120	12 ,,	30
42 ,,	340	370	390	14 ,,	40 ,,	36	48 ,,	120	14 ,,	35
48 ,,	430	460	480	17 ,,	40 ,,	40	54 ,,	110	16 ,,	40

The apparatus for cutting deals will be found a most useful addition to the machine. For prices of saws, see list.

DEAL FRAMES.



The swing frames are made throughout of wrought-iron, and are in two compartments, the connecting rod passing centrally between them. By this arrangement a long connecting rod and a corresponding steadiness is obtained, as well as a reduction in the amount of friction.

The deals are carried by cast-iron rollers, with wrought-iron spindles, having their bearings on iron standards bolted to the floor, and a rack with hinged dogs brings the deals up to the saws.

Size for two Deals.	Price.	Number of Saws.	Weight about	Power required.	Diam. of Pulley.	Revolutions per minute.
14 in. × 4 in.	£150	24	3½ tons.	4 H. P.	30 in.	200
18 in. × 5 in.	190	26	4 ,,	5 ,,	36 ,,	.180
26 in. × 7 in.	220	36	5 ,,	6 ,,	42 ,,	140

A plainer frame answering the foregoing general description is made, as follows:—

Size for two Deals.	Price.	Number of Saws.	Weight about	Power required.	Diam. of Pulley.	Revolutions per minute.
11 in. × 3 in.	£130	24	2 tons.	3 H.P.	30 in.	220
18 in. × 4 in.	160	26	3 ,,	5 ,,	36 ,,	180
24 in. × 6 in.	185	36	5 ,,	6 ,,	42 ,,	140

The above prices do not include saws, buckles, steel keys, and driving straps, for prices of which see the several lists.

PORTABLE LOG OR DEAL FRAME.

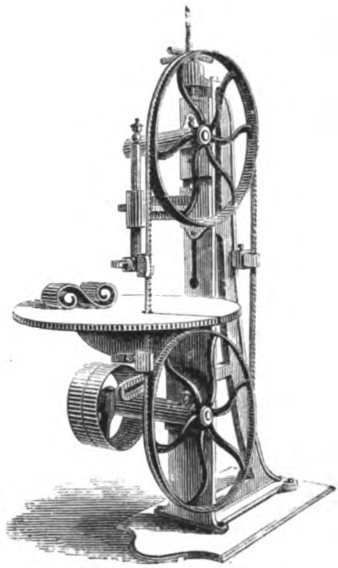
A Portable Saw Frame is made, generally similar in design to those already described, but mounted on a set of wood travelling wheels, with locking carriage, shafts, &c. for facility of moving about from place to place.

These machines will cut either logs or deals, and are driven by an ordinary portable engine, or a traction engine; they have been used rather extensively in the forests of Russia, Norway, &c. as well as by contractors and builders in this and other countries.

To cut 2 deals	11 in.	× 3 in.,	or logs 12 in.	square	Price	£220.
,, 2 ,,	14 ,,	× 3	,, 14	,,	,,	230.
,, 2 ,,	18 ,,	× 4	,, 18	,,	,,	250.
,, 2 ,,	24 ,,	× 6	,, 24	,,	,,	265.

The powers required, speeds, and other conditions, are similar to those given for the fixed Frames.

ENDLESS BAND SAWS.



These machines are adapted to every variety of work, whether for cutting the sharpest sweeps, the most delicate fret-work, or sawing an oak plank fifteen inches thick; and there are few establishments where they may not be profitably employed.

The table is planed, and made to fix at any angle up to 45°, and the upper pulley has a compensating arrangement to maintain an equal tension on the blade, and prevent injury to the work, or breakage of the saw from expansion or contraction; they can also be fitted with a radial arm for cutting a sweep of any given radius, such as the felloe of a wheel, &c. without the necessity of marking out.

Diameter of Saw Pulley.	Will cut any thickness up to	Price.	Weight.	Diameter of Driving Pulley.	Revolutions per minute.
27 in.	8 in.	£38 0 0	20 cwt.	14 in.	450
30 ,,	10 ,,	65 0 0	36 ,,	16 ,,	400
40 ,,	15 ,,	80 0 0	48 ,,	18 ,,	350

They are also becoming extensively used in our arsenals and locomotive works, for cutting out irregular forms in iron and brass, such as the sides of wrought-iron gun carriages, locomotive frames, &c. &c. with the greatest success. The metal is sawn cold, and the blades do not require sharpening oftener than every three or four hours; the average rate of cut is about 3 inches per minute in 1 inch wrought-iron plate, and 6 inches per minute in brass, and the work is clean and true; the speed of travel of the blade should be 200 to 250 feet per minute. The machines for this purpose require to be fitted with counter-shaft and cone pullies to reduce and vary the speed; the tables are also extra large and strong, and are planed on the top.

36 in. diameter Saw Pulleys	Price £105 0 0	including
42 ,, ,,	,, 170 0 0	counter-shafts.

A useful accessory to the band saws is Perin's Saw Sharpening Frame, which greatly facilitates the work. They are made in four sizes, as follows—and the small forge and tools for brazing, enables an ordinary workman to braze his own saws at a nominal cost.

BAND SAW SHARPENING FRAME.

No. 1 to take in saws 11 ft. to 14 ft. long	£9	10	0
No. 2 „ „ 14 ft. to 17 ft. „	11	0	0
No. 3 „ „ 17 ft. to 20 ft. „	12	0	0
No. 4 „ „ 20 ft. to 23 ft. „	13	0	0

SAW BRAZING APPARATUS AND TOOLS.

Price £5 10 0

PERIN'S PATENT BAND SAW BLADES.

WIDTH.	LENGTH IN FEET.																							
	13		14		15		16		17		18		19		20		21		22		23		24	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
⅛ 3/16 ¼ 5/16 in.	9	9	10	6	11	3	12	0	12	9	13	6	14	3	15	0	15	9	16	6	17	3	18	0
⅜ in. . . .	10	6	11	6	12	3	13	0	14	0	14	6	15	6	16	6	17	3	18	0	19	0	19	9
½ in. . . .	11	6	12	3	13	3	14	0	15	0	15	9	16	6	17	6	18	6	19	6	20	6	21	6
⅝ in. . . .	12	3	13	3	14	3	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0
¾ in. . . .	13	0	14	0	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0	24	0
⅞ in. . . .	14	0	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0	24	0	25	0
1 in. . . .	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0	24	0	25	0	26	0
1¼ in. . . .	17	6	18	9	20	0	21	3	22	6	23	9	25	0	26	3	27	6	28	9	30	0	31	3
1½ in. . . .	19	6	21	0	22	6	24	0	25	6	27	0	28	6	30	0	31	6	33	0	34	6	36	0

2 in. . . .	Of any length up to 50 ft. at 2*s.* per ft.	4 in. . . .	Of any length up to 50 ft. at 4*s.* per ft.
2½ in. . .	„ „ 2*s.* 6*d.* „	5 in. . .	„ „ 5*s.* „
3 in. . .	„ „ 3*s.* „	6 in. . .	„ „ 6*s.* „

Endless Band Knives for cutting Linen or Cloth, at 25 per cent. above the list prices of the Saws.

Band Saws, for sawing Iron and Brass, of any size to order.

PRICES OF FRAME SAWS.

Complete, with buckles, tillers, cotters, &c. for frames of the following sizes:—

Deal frames . .	12	24 inch.
	12/0	25/0 each.

Log frames . . .	16	20	24	30	36	42	48	60	72 inch.
	15/0	20/0	25/0	30/0	35/0	40/0	45/0	55/0	70/0 each.

WOOD BORING MACHINES.

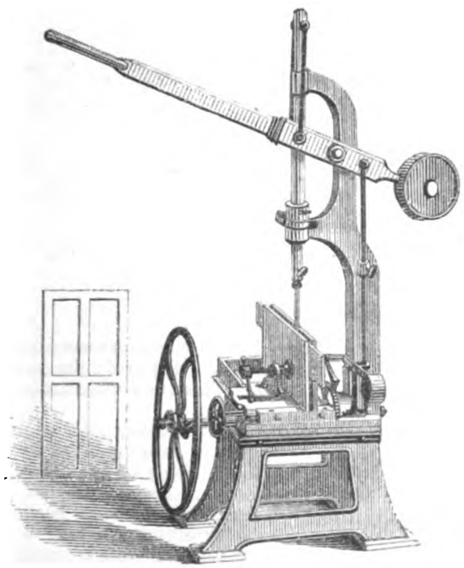
These machines are made to work horizontally or vertically, the latter being either on an independent frame or to attach to a wall, and each kind is made in two sizes.

The horizontal machine will bore holes up to 3 inches diameter and 12 inches deep; the table for carrying the timber is fitted with planed angle plates, cross slide for traversing the wood operated on, and a vertical slide with hand wheel and screw for raising or lowering the timber ; the feed to the auger is given by a rack and pinion and hand wheel.

The vertical machine has a similar feed motion, or a counterbalanced spindle to work by hand or foot. The largest machines of each kind are fitted with cone pulleys and counter-shafts to give a variable speed to the auger.

Size.	Vertical Machines.	Horizontal Machines.	Weight about	Diameter of Driving Pulley.	Speed of Spindle.	Power required.
	£ s. d.	£ s. d.	Cwt.	inches.	Revolutions.	
No. 1.	40 0 0	50 0 0	10	9	1,500	½ H.P.
No. 2.	60 0 0	75 0 0	20	Cones.	variable.	½ ,,

MORTICING MACHINES.



Morticing Machine for Hard or Soft Wood.

The chisel is made to work by hand or foot leverage, in both cases the whole of the motion being perfectly balanced, and these machines are capable of morticing door stiles 11 inches deep. If the machine is fitted with the foot lever the work is held against a parallel fence and moved forward as required, the table being made to rise and fall to suit different thicknesses of timber, and the fence has a screw adjustment as well as adjustable stops to keep the work from rising when the chisel is withdrawn.

The lever machine is a stronger and more powerful tool, and the table for carrying the timber is fitted with vertical and transverse slide motions; the timber is moved transversely by means of a hand wheel and rack and pinion, a clamping screw is also provided to fasten the work up to the fence; both the machines being self-contained they require no massive foundation or expense in fixing.

It is estimated that a boy working one of these machines will easily do as much work as six men morticing by hand. Larger machines are made for power, and are entirely self-acting in all their motions, that is to say, the work is fed forward to the chisel at any desired speed; the chisel can be made to give any depth of stroke from 1 inch to 11 inches; the table is not adjustable in height, but the chisel slide can be altered to suit varying thicknesses of timber.

PRICES OF MORTICING MACHINES.

Price of Foot Machines.	Price of Hand Lever Machines.	Price of Power Machines.	Approximate Weight.	Diameter of Driving Pulley.	No. of Revolutions per Minute.	Power required.
£ s. d.	£ s. d.	£ s. d.	cwt.	inches.		
16 10 0	22 0 0	65 0 0	25	12	2 0	½ H.P.
—	—	110 0 0	40	16	[illegible]0	1 „

COMBINED MORTICING AND BORING MACHINES.

This machine is a combination of the two last described, and is well adapted for morticing hard wood; the boring tool first boring a number of holes and the chisel finishing the hole out square; it can also be used separately for either purpose, and the small size will cut mortices of any size up to 1½ inches wide × 10 inches deep, and the large size will cut mortices 2½ inches wide × 12 inches deep.

Size.	Prices.	Weight.	Diameter of Pulleys.	Revolutions per Minute of Pulley.	Power required.
	£ s. d.	cwt.	inches.		
No. 1.	132 0 0	30	16	180	1½ H.P.
No. 2.	165 0 0	55	18	160	2 „

TENONING MACHINES.

Tenoning Machines are usually either cutter blocks revolving at high speeds, or saws capable of being set any given distance apart according to the strength of tenon required; the former are most used for the lightest class of work, such as sashes, shutters, doors, and cabinetmakers' work, and the latter in railway shops and for heavy work.

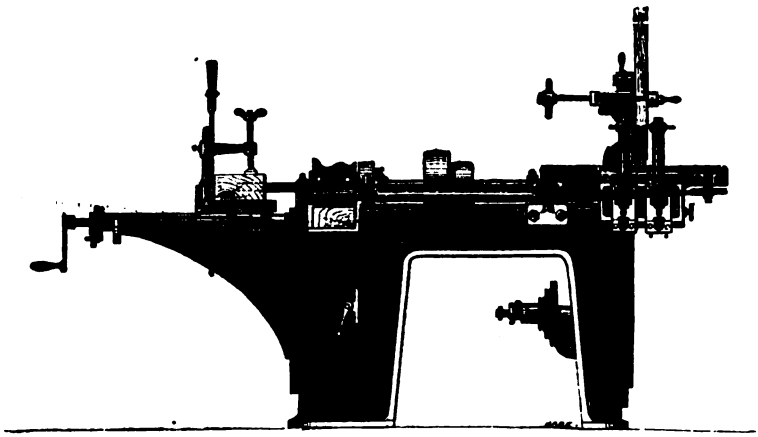
The small machine is fitted with two cutter blocks, capable of adjustment, and the timber to be tenoned is placed against a guide plate, and held fast by a lever on a sliding table, which moves at right angles to the cutters; the table and timber is then moved along by hand, passing the timber between the cutter blocks, and both sides of the tenon are cut at one operation perfectly clean and true, and without setting out. This machine can also be made for scribing sash-work, trenching sash heads, or sills, &c. A hand lever is fitted for binding the belt to the pulleys of the cutter spindles, whatever their position, or for instantly stopping them if required.

The large tenoning machine has a vertical spindle carrying two saws, and two horizontal spindles, each with a small saw; the timber to be operated upon is clamped to a saddle sliding on a planed bed, and fed up to the saws by self-acting mechanism with a quick return motion to bring the work back; the vertical saw spindle is placed in advance of the horizontal saws

and they can be set to cut any size of tenon, square, with unequal or angular shoulders, at one operation. The counter-shaft for driving the various motions is fixed at the end of the machine.

Size.	Price.			Weight about	Diameter of Pulleys on Counter-shaft.	Speed of Counter-shaft.	Power required.
	£	s.	d.	cwt.	inches.	Revolutions.	
No. 1.	55	0	0	11	16	400	1 H. P.
No. 2.	165	0	0	78	16	400	4 „

PATENT GENERAL JOINER.



These useful tools, as their name implies, will do most of the work performed by the joiner, such as sawing, mitering, chamfering, wedge-cutting, tenoning (single or double tenons), planing, moulding, beading, rebating, grooving, tonguing, and squaring up scantling, morticing, boring, &c. and all these operations can be worked separately without alteration or loss of time; in fact it is a perfect combination of most of the machines before described, and one man and a boy will perform an amount of work equal to that of twenty to twenty-five skilled joiners; it is fitted with a counter-shaft with fast and loose pulleys.

Price.			Weight.	Diameter of Pulley on Counter-shaft.	Speed of Counter-shaft.	Power required.
£	s.	d.	cwt.	inches.	Revolutions.	
170	0	0	25	12 × 4 wide	600	1 H. P.

The following data may be useful to show the amount of work which can be performed in a given time.

One man will stick 600 feet of 3 in. moulding in an hour, while a lad may make eighty mortices at the table at the same time.

One man and a boy will prepare the whole of the stuff for thirty 2 in. doors in 10 hours.

One man and a boy will mortice, tenon, mould, rebate, scribe, and stick the sash bars for thirty-six pairs of sashes, 7 ft. × 4 ft. in 10 hours.

One man and a boy will stick the parting beads, groove the pulley stiles, cross tongue, sink, and level the sills for twenty-eight sash frames in 10 hours.

Less expensive "General Joiners" are made, down to about £95, but they are not so complete as that above described, although good useful tools.

SQUARING-UP MACHINES.

This machine will square-up or plane logs up to 30 in. square, and of 70 feet long, the lower bed being 140 feet long; the woodwork for forming the bed is usually supplied by the purchaser; a detailed drawing with all dimensions being supplied, it is quite plain work, and can be easily executed by any ordinary carpenter, and this often saves a large amount of money, in land carriage or freight; the whole of the gearing, including all racks, bolts, slides, screw dog for holding down the timber, foundation bolts, and complete set of cutters are supplied. The smaller size to square-up logs 21 in. × 18 in. × 35 ft. long, are fitted complete with a cast-iron travelling table planed over the top; this slides over cast-iron rails, also planed to receive the table. Either of the machines can be made longer or shorter if required.

Size to Plane.	Price.*	Weight.	Power required.
	£ s. d.		
30 in. × 30 in. × 70 feet.	330 0 0	10 tons.	4 H. P.
18 „ × 18 „ × 24 „	220 0 0	7 tons, 10 cwt.	3 „
15 „ × 15 „ × 21 „	195 0 0	6 tons, 10 cwt.	3 „

* Exclusive of woodwork.

WOOD PLANING MACHINES.

These machines will plane, joint, tongue, and groove, rebate and thickness all kinds of timber at speeds up to 48 feet per minute.

The machine is fed by means of five pairs of turned rollers, the five top ones being arranged so that they can be regulated to any required thickness of timber during its passage through the machine.

The boards are thicknessed by a plane-iron fixed on a plane-bed, and a spare plane-bed is supplied with each machine.

Rotating cutters or scutchers operate on the upper surface and edges, simultaneously making tongues and grooves, half checking or plain work as desired.

Between the first and second pairs of rollers an under scutcher rotates, which in coarse or dirty work skims the under surface; this relieves the plane-irons, and enables them to keep their edge much longer.

This machine is also well adapted for working large mouldings, spoutings, rounds, &c. and is made in three sizes, as follows:

Size to Plane.	Price.			Weight.	Power required.
	£	s.	d.		
5 inches × 12 inches.	330	0	0	10 tons.	6 H.P.
6 ,, × 15 ,,	380	0	0	11 ,,	7 ,,
8 ,, × 22 ,,	450	0	0	12 ,,	9 ,,

COMBINED PLANING AND MOULDING MACHINES.

These machines are adapted for operating on timber nine inches to two inches broad, and four inches to one-fourth of an inch thick, working the four sides at once or singly; the timber is fed forward by five pairs of rollers, motion to which is given by bevel wheels and pinions driven by a shaft at the back of the machine.

The five upper rollers can be adjusted in height to the thickness of the timber, by means of screws set in frames, the screws at the same time regulating the levers and weights.

The under side of the timber is operated on, first by a rotary scutcher, and finished by a plane-bed, easily removed; a spare one being supplied with each machine.

The small machine is generally similar in construction to that above described, but is for shorter work, and has only three pairs of feed rollers.

	Price.	Weight.	H. P. required.
Large machine . . .	£275 0 0	4 tons, 14 cwt.	6
Small ,, . . .	220 0 0	3 ,, 15 ,,	5

MOULDING MACHINES.

This tool is fitted with rotary cutters which operate on both sides of the timber at once, and it will make mouldings of any size up to seven inches broad. It is made as light and compact as may be, consistently with durability, and it may be bolted to any ordinary floor.

Price £75 0 0

Weight, about 20 cwt. Power required, about 3 H.P.

MACHINERY FOR MAKING DRY STUFF CASKS.

The machine for cutting out the heading has a vertical hollow spindle, carrying a double disc plate with cutters. These cutters can be moved simultaneously to or from the centre by turning the disc plate in reverse directions, an index on the edges showing exactly the diameter they will cut, and when set they are made fast together by clamping bolts.

The boards to be cut are laid together in position on the table below the cutters, and a clamp working through the hollow spindle is pressed on them by a lever and screw, and keeps them firm ; the cutter discs are then brought down by a hand lever, and cut out the circular heading, a balance weight taking up the spindle and cutters the moment the hand lever is released.

This machine will cut headings from 28 inches to 40 inches diameter.

Price £65 0 0

Weight, about 35 cwt. Power required, 1 H. P.

CASK TRUSSING MACHINE FOR MAKING "DRY STUFF CASKS."

The staves having been previously shaped to their proper curve and bevel by a circular saw specially adapted to the purpose, they are gathered together at one end in an iron hoop, a second hoop being placed about the bilge simply to keep them together.

They are then steamed for a few minutes under a steaming pan, and "screw grips" are run out sufficiently wide to receive them, and the staves which are held together by the hoops above-named are put in place. The machine is then set to work by the belt being thrown on to the fast pulley, which causes the grips to come together simultaneously and form the cask in a few seconds.

The machine is also fitted with a reverse motion obtained by an open and cross belt which runs the grips out ready for the next cask.

This machine entirely supersedes the use of wooden truss hoops in making casks for containing flour, sugar, and other commodities known as "dry stuffs," and at a cost quite unattainable by hand-labour, the staves being properly prepared, a man and two boys with very little practice turning out 100 sugar casks of 36 or 38 staves per day.

Price £65 0 0

Weight, 25 cwt. Power required about ½ H. P.

WHEEL MAKING MACHINES.

In large wheel making establishments the subjoined tools are required, but as they may be considered *special* machines, and are usually made to suit some particular class of work it will perhaps be unnecessary to do more than enumerate them :

Spoke Turning Lathe,
Spoke Tenoning Machine,
Nave Turning Lathe,
Nave Morticing Machine,
Setting up Machine for Driving Spokes into Naves,
Tire Bending Rollers,
Tiring Plate and Water Tank complete,
Machine for cutting out Felloes, both sides at once,
Lathe for Finishing and Chamfering Felloes,

but in most works where wheels are made even on a small scale a Band Saw may be very profitably employed, as well as the Spoke Turning Lathe hereafter described, as both of these tools can be used for an almost infinite variety of work. Special machines are also made for

MAKING LUCIFER MATCH SPLINTS,
CEDAR PENCIL MAKING,
FIRE WOOD SPLITTING,
SAWING, ADZING, AND BORING RAILWAY SLEEPERS, ETC. ETC.

SPOKE TURNING LATHE.

In general design this machine somewhat resembles an ordinary turning lathe, but it has treble headstocks at both ends, and a traversing headstock carrying the revolving cutters, which are kept up to their work by a weight, until the spoke or other article is finished. This tool will turn a perfectly parallel oval, or form a taper on the spoke, or will turn the article larger or smaller than the pattern or "dummy." It is self-acting in all motions, and will turn out two spokes or hammer shafts at a time, or say about 400 per day.

Size.	Price.	Weight.	Diameter of Pulley.	Speed of Pulley.	Power required.
No. 1.	£80 0 0	25 cwt.	14	550 revs.	½ H. P.
No. 2.	95 0 0	32 ,,	16	500 ,,	1 ,,

The No. 1 machine will take in spokes 3 feet long × 4 inches broad, and the No. 2 machine spokes 3 feet long × 6 inches broad.

TIMBER TRAVELLERS AND HAULING MACHINES.

In large mills, where heavy logs of timber have to be brought up to the Rack Bench or Timber Frame from the water-side, a STEAM HAULING MACHINE is frequently used, which drags the timber with a chain and dogs, out of the water, up an incline, and places it close to the Bench or Frame.

For moving and stacking timber in various parts of the storage yard, and for placing it in position for sawing, and removal after cutting, an overhead traveller worked by steam or by an endless rope will be found economical in saving time and manual labour. In some instances an ordinary overhead traveller worked by steam or hand, and as described in the respective sections, may be advantageously employed, but where the necessary timber staging or other preparation does not exist, the authors have successfully adopted a Goliath similar to that described at page 19. With this arrangement, the rails being laid on the ground, no structure is required beyond the Goliath itself, and the whole space is free from any obstruction to logs being rolled into the path of the traveller, which the ordinary permanent traveller staging presents. These Goliaths have been made of various spans and to lift any weight up to 20 tons; they can of course be made for heavier weights, but they will probably not be required for the purpose under consideration.

GRINDSTONE FOR GRINDING MOULDING IRONS.

FIVE stones, each of different thickness, are mounted on one spindle, and fitted with a water-tight wrought-iron trough and cast-iron water cistern, with a tap opposite each stone.

Price £12 0 0

Weight, 3 cwt.

WATER OF AYR LAPSTONE.

A CAST-IRON water-trough serves as a frame for carrying a spindle and disc plate in which the Water of Ayr Stones are fixed in segments; a long moveable rest is provided which can be set to any angle with the face of the stone.

Price £11 0 0

Weight, 5 cwt.

SAW-PUNCHING, OR GULLETTING PRESS.

THIS press is arranged for punching out the teeth of either Mill Saws or Circular Saws when they are worn too short, and its use will effect a considerable saving in time, and saw files, in addition to the accuracy of its work.

Price £16 10 0

Weight, 10 cwt.

Dies for Saw Teeth from £1 5 0 to £2 10 0 per set.

SAW SHARPENING MACHINE.

THIS tool is specially made for sharpening the teeth of all kinds of saws used in the machines described in the foregoing articles.

The saws for timber and deal frames are held in a vice similar to that used for sharpening by hand, but it can be traversed by a rack and pinion motion; the sharpening disc is an emery wheel keyed on a spindle which is carried in a balanced swing frame, and can be set to any angle so as to perform the several operations of gulletting, topping, or bevelling. Circular saws are fixed on a spindle with a rising and falling motion which can be adjusted to suit any diameter of saw.

The teeth are completely finished without filing, and beside the great saving in time, the machine effects a saving in files of from 25 to 30 per cent.

Price £33 0 0

Weight, about 20 cwt.

MOULDING CUTTERS, price	£0	10	0	per inch in diameter.
Ditto, for Moulding Machines . .	0	1	6	„ in width.
Ditto, for Tenoning Machines . .	0	4	0	„ „
Boring Augers	0	4	6	each.

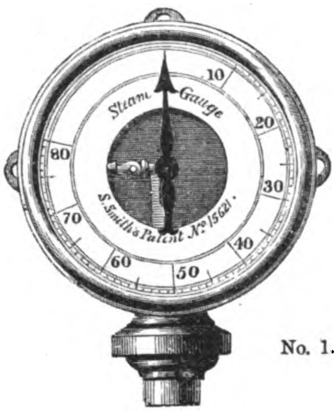
STEAM AND BOILER FITTINGS,

GAUGES, BRASS MOUNTINGS,

&c. &c.

U

PRESSURE GAUGES.



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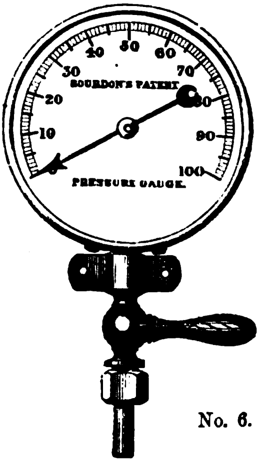

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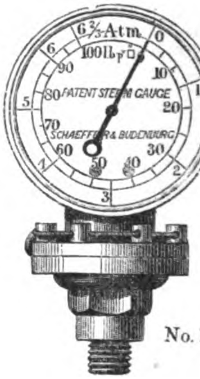

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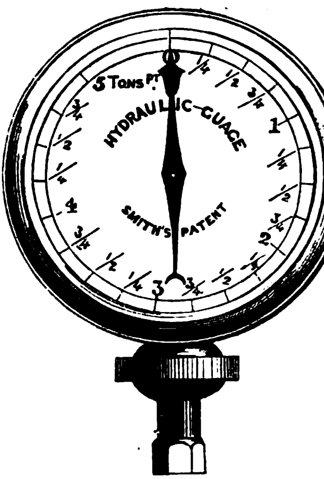


	£	s.	d.
No. 1.—7 in. Open Dial Steam Pressure Gauge, in polished brass highly finished	2	6	6
No. 2.—6 in. Open Dial Steam Pressure Gauge (same pattern as No. 1.) in polished brass and syphon complete	2	3	0
No. 3.—6 in, closed Dial ditto, in polished brass	2	0	0
Ditto,—6 in. ditto, in painted case	1	17	6
Ditto,—5 in. ditto, in polished brass	1	17	6
No. 4.—4 in, ditto, in polished brass, suitable for Portable Engine	1	13	6
Ditto,—3 in. ditto, in Polished brass	1	7	0
No. 5.—6 in. Hydraulic Gauge, 1 to 3 Tons	4	0	0
No. 6.—7 in. Bourdon's Patent Steam Pressure Gauge in polished brass with tap	2	15	0
No. 7.—7 in. ditto, Vacuum Gauge in polished brass with tap	2	15	0
No. 8.—6 in. ditto, Steam pressure Gauge in polished brass with tap	2	10	0
No. 9.—5 in. ditto, ditto, ditto	2	4	0
No. 10.—4 in. ditto, ditto, ditto, for portable Engines	1	17	6
No. 11.—6 in. Dial, Schæffer's Patent Steam Pressure Gauge metal case, brass rim	2	7	0
Ditto.—6 in. ditto, in brass case	3	0	0
No. 12.—4 in ditto, metal case, brass rim	1	13	6
No. 13.—6 in. Schæffer's patent Hydraulic Gauge, with maximum pointer from 2,000lbs. to 10 Tons	4	0	0
Ditto.—9 in. ditto, from 2,000lbs. up to 10 Tons	5	0	0

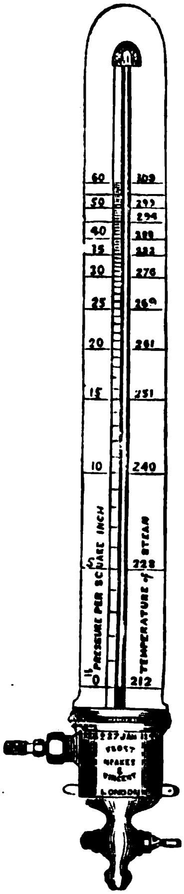
No. 13a.—Salter's Steam Pressure Gauges, in iron case with

syphons	3½	4	5	6 inches.
each	£1 5s.	£1 6s.	£1 8s.	£1 10s.
Ditto in Brass cases	£1 7s. 6d.	£1 9s.	£1 12s.	£1 15s.

No. 13b.—Patent Pyrometer or Heat Gauge for indicating high temperatures beyond the range of mercurial thermometers, for application to blast furnaces, ovens, stoves, &c. up to 1,000 degrees Fahrenheit, £4 4s. each.

Iron Bracket to fix to a wall, with levers and rod for Balance.
To carry 3 cwt. 35/0; to carry 3 to 6 cwt. 42/6.

Scale with Double Iron Arms and Iron Bottom for luggage, &c.
To carry 3 cwt. 26/6; to carry 3 to 6 cwt. 37/0.



No. 14. HOPKINSON'S PATENT MERCURIAL STEAM AND VACUUM GAUGE.

These instruments are very superior for simplicity of construction, certainty of action, and accuracy of indication, depending solely on the direct weight of the open mercurial column.

Price complete, with mercury, £4 4s. 0d.

They are adopted by Her Majesty's Government as TEST GAUGES.

No. 14A. PATENT MERCURIAL STEAM PRESSURE AND VACUUM GAUGE,

In polished gun metal frame, complete with gun metal cock and union connection. Small size, £1 10s. 0d. each.

Large ,, 2 2 0 ,,

No. 14B. MERCURIAL STEAM PRESSURE AND VACUUM GAUGE,

In mahogany case, glass front, silvered index plate, with union connection at side, £1 10s. 0d. each.

No. 14C. MERCURIAL STEAM PRESSURE GAUGE,

On painted board, with iron syphon, brass safety-box, index-pointer, wheel and line, &c. £2 14s. 0d.

Mercury, per lb.

No. 14A.

No. 14D. SUPER-HEATED STEAM THERMOMETERS,

With patent porcelain scales and iron mountings, £1 10s. 0d.

Ditto ditto with brass mountings, 1 16 0

No. 14E. SUGAR PAN VACUUM GAUGE,

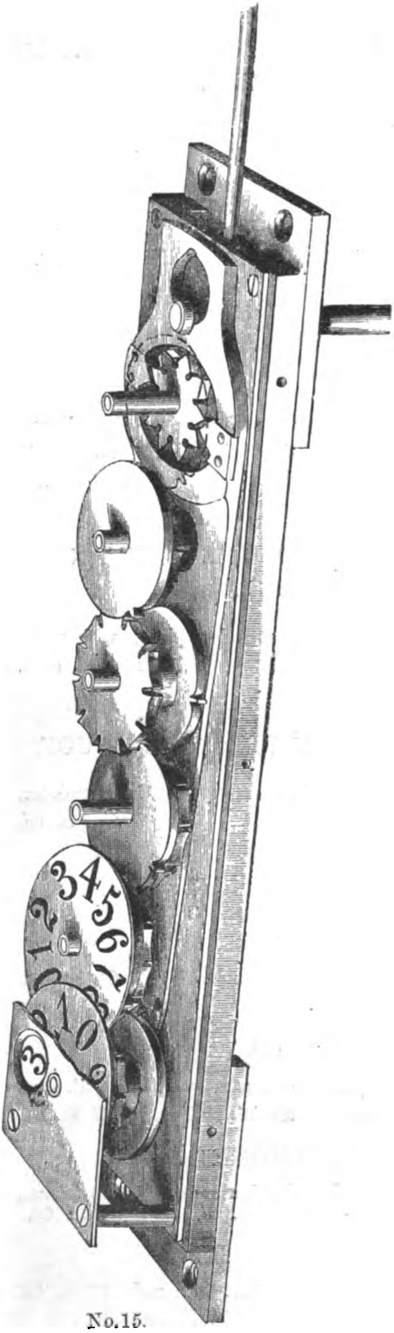
With tube and scale enclosed in stout glass cylinder, and brass case complete, with door and hinges, ground plug and stop-cock for fitting it to pan, £1 16s. 0d. and £3 0s. 0d.

No. 14F. STEAM PRESSURE THERMOMETER,

In strong brass case, with plug for closing the boiler, when the thermometer is not in use, each £1 10s. 0d, and £2 8s. 0d.

No. 14G. VACUUM PAN THERMOMETER,

In strong brass case with hinge door, as 14 F. £1 16s. 0d. and £3 0s. 0d.



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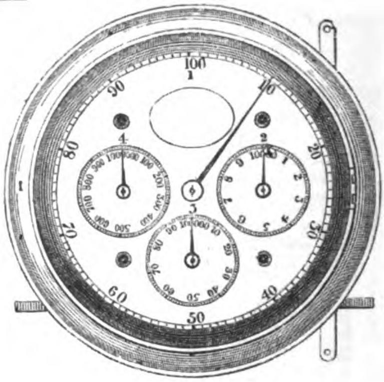


No. 16A.

No. 15. SCHÆFFER'S IMPROVED ENGINE COUNTER for counting oscillating motion or reciprocating strokes of steam engines.

	£	s.	d.
With four dials or figures to count up to 10,000	2	13	6
With five ditto ditto 100,000 .	3	0	0
With six ditto ditto 1,000,000 .	3	7	6

No. 16. NEW IMPROVED COUNTER OF ROTARY MOTION OR REVOLUTIONS.

	£	s.	d.
With six dials or figures to count up to 1,000,000	1	15	0

No. 16A. RICHMOND'S PATENT ENGINE COUNTER.

	£	s.	d.
No. 1 size, large, in mahogany, 9½ in. dial, to register 1,000,000	7	15	0
No. 2 size, ditto, ditto, 10,000,000.	8	5	0
No. 3 ditto, for marine purposes, to register 10,000,000	9	0	0
Small ditto, in iron case	7	5	0
No. 4 Small ditto in iron case to register 1,000,000	6	10	0

RICHMOND'S CHAMPION ENGINE COUNTER, especially adapted for high speeds.

	£	s.	d.
No. 5 size, 6½ in. dial, in iron case, complete, to register 1,000,000 . . .	10	0	0
No. 6 size, ditto, 100,000	9	10	0

IMPROVED PATENT SELF-ACTING SYPHON BOXES OR STEAM TRAPS.

FOR THE DISCHARGE OF CONDENSED STEAM IN PIPES, VACUUM PANS, STEAM COOKING APPARATUS, DRYING ROOMS, DRYING CYLINDERS, STEAM CHESTS, STEAM HAMMERS, &c.

No. 17.

No. 17.—Cast-iron Steam Trap or condense box with strong copper float, gun-metal valve and spindle complete—

Diameter 4 in.	6½ in.	7½ in.	9 in.	12 in.	15 in.
£2 10*s.*	£3 3*s.*	£4 4*s.*	£5 17*s.* 6*d.*	£8 8*s.*	£11 15*s.*

No. 17 A.—Schaffer's, 11 in. 16 in. diameter.
Price, £1 15*s.* £2 5*s.*

No. 18.—Bünger's, £4 4*s.*

No. 18 A.—Leatham's 14 high × 12 deep. 18 × 17. 23 × 22 in. deep.
Price, £2 15*s* £3 15*s.* £5 15*s.*

No. 18 B.—Whitley's, with gun-metal working parts.
13 × 8½ × 7½ 26 × 17 × 15 in.
Price, £2 10*s.* £5

No 18 C.—Robertson's 13 in. diam. × 16 in. deep, £2 10*s.*

Richard's patent STEAM ENGINE INDICATORS—Price £8 10*s.*

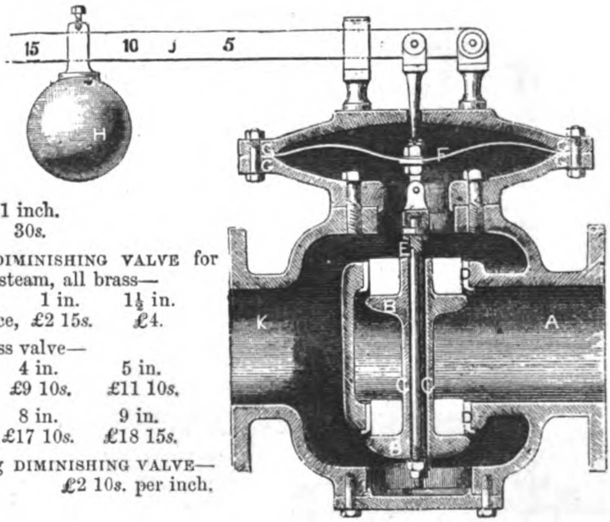
No. 19.—PATENT DOUBLE VALVE ½ ¾ 1 inch.
Price, 16*s.* 22*s.* 6*d.* 30*s.*

No. 20.—New improved DIMINISHING VALVE for reducing the pressure of steam, all brass—
1 in. 1½ in.
Price, £2 15*s.* £4.

In iron, with brass valve—

2 in.	3 in.	4 in.	5 in.
£5 10*s.*	£7 10*s.*	£9 10*s.*	£11 10*s.*
6 in.	7 in.	8 in.	9 in.
£13 5*s.*	£15 10*s.*	£17 10*s.*	£18 15*s.*

No. 21.—Holt's self-acting DIMINISHING VALVE—£2 10*s.* per inch.

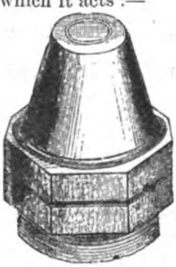


No. 21.

22. SMITH'S PATENT DOUBLE-CONE FUSIBLE PLUG,

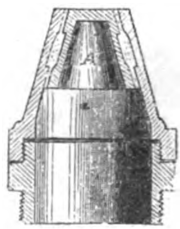
AS USED BY THE NATIONAL BOILER INSURANCE COMPANY.

The great superiority of this over other fusible Plugs is the peculiar and effective mode in which it acts :—



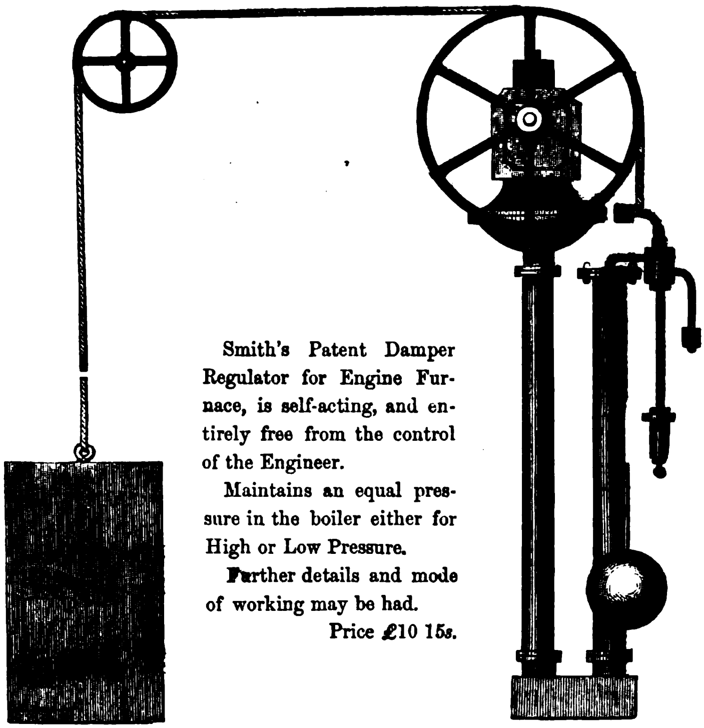
When the Boiler becomes short of water, the soft fusible metal which unites the brass cones is melted and *the inner cone (A) falls away, leaving a* LARGE CLEAR *opening*, through which the steam rushes and extinguishes the fire, thus saving the boiler from injury.

PRICES.	£	s.	d.
No. 1. suitable for locomotive and portable boilers	0	10	0
No. 2. suitable for small boilers, including extra loose cap	0	16	0
No. 3. suitable for all kinds of internally-fired boilers, including extra loose cap .	1	4	0



These Plugs are made of the best metal, and are accurately and carefully finished. Each Plug is tested by hydraulic pressure before being sent out. Suitable keys to fit the No. 3 Plugs may be had with them, price 2*s.* 6*d.* each.

N.B.—When ordering the Plug, the Load on the Safety Valve should be stated.

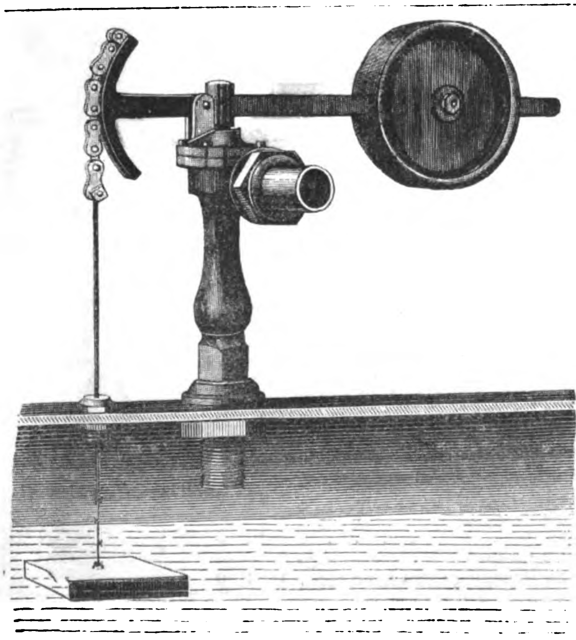


Smith's Patent Damper Regulator for Engine Furnace, is self-acting, and entirely free from the control of the Engineer.

Maintains an equal pressure in the boiler either for High or Low Pressure.

Further details and mode of working may be had.

Price £10 15s.

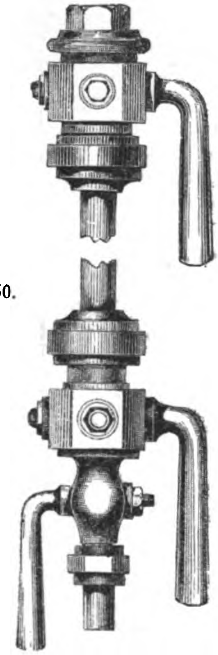


GUN METAL DIAPHRAGM FEEDING APPARATUS

For Steam Boilers, complete with Float Stone, Balance Weight, Stuffing Box, &c.

Price £1 17s. 6d.

No. 50.



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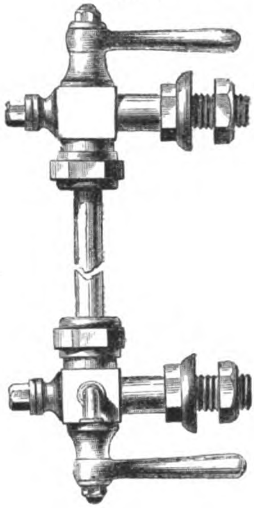

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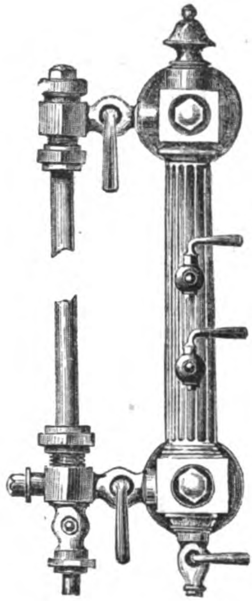

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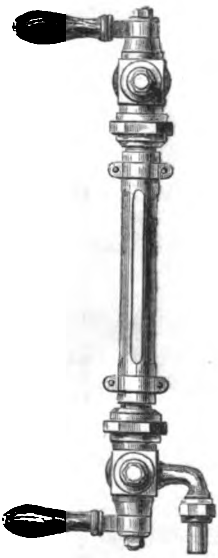

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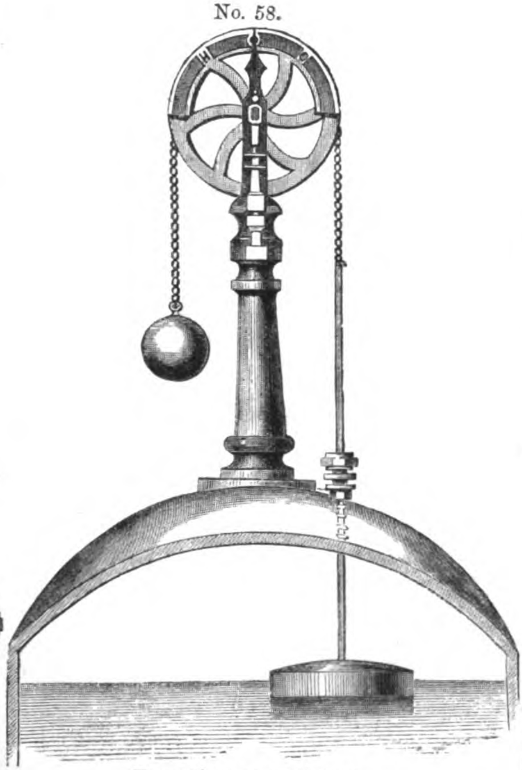


For prices see next page.

NO.	DIAMETER OF BORE.	½ in.	⅝ in.	¾ in.	⅞ in.	
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	
50.	Water Gauge, strong	1 3 9	1 6 3	1 6 3	1 10 0	per set.
51.	Ditto, same pattern but lighter.	1 1 6	1 1 6	1 1 6	—	,,
52.	Ditto, with flanges extra strong.	1 6 3	1 10 0	1 12 0	1 16 0	,,
53.	Hollow Plug Water Gauge . .	1 8 6	1 11 0	1 13 6	1 16 0	,,
54.	Compound Water Gauge, with Iron Pillar and Gauge Cocks, complete.	—	2 8 0	—	—	,,
55.	Gland Water Gauge with Guard.	1 0 6	1 1 6	—	—	,,
56.	Water Gauge with Whistle and Guard.	1 11 0	1 11 0	—	—	,,
57.	Hollow Plug Water Gauge with Guard.	1 1 6	1 3 9	—	—	,,

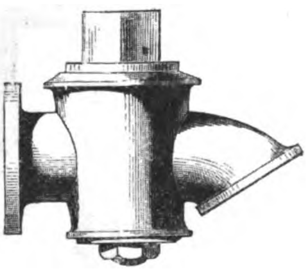
BEST GLASS TUBES FOR WATER GAUGES.

	Length.	12	13	14	15	16	17	18	inches per dozen.
outside diam.	½	5/0	6/0	6/0	7/6	8/0	—	—	
	$\frac{9}{16}$ & ⅝	6/0	7/6	8/0	9/0	9/6	—	—	,,
	¾	11/0	11/6	12/0	13/0	13/6	—	—	,,
	⅞	—	—	—	—	18/0	19/0	19/0	,,
	1	—	—		—	26/0	27/0	27/0	,,

BEST VULCANIZED INDIA RUBBER RINGS FOR GAUGE GLASSES. 9*d.* per dozen.

58. Self-acting Alarm Valve and Water Indicator with stone float and ball complete. £2 13*s.* 6*d.*

58A. Johnstone's patent self-acting Alarm Whistle and Float, so constructed that it cannot become waterlogged (no woodcut) . . . . £2 15*s.* 0*d.*



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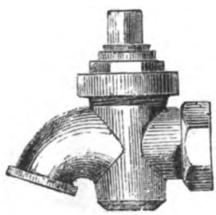

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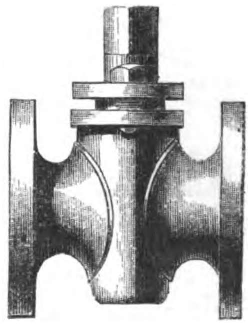
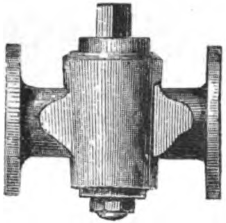


No. 72.

	DIAMETER OF BORE.	¾ in.	1 in.	1¼ in.	1½ in.	1¾ in.	2 in.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
70.	Blow-off Cock with flange.	0 8 0	0 11 4	0 15 9	0 18 3	1 6 4	1 15 0
,,	ditto Best.	0 12 8	0 18 0	1 4 0	1 11 0	—	2 13 0
71.	Gland Bib Cock.	0 6 4	0 10 2	0 16 2	1 1 6	—	—
72.	Gland Cock with flanges, London Pattern.	0 10 6	0 15 0	1 2 2	1 11 3	—	2 7 0
,,	ditto Best.	1 1 0	1 9 0	1 18 6	2 8 0	—	3 12 0



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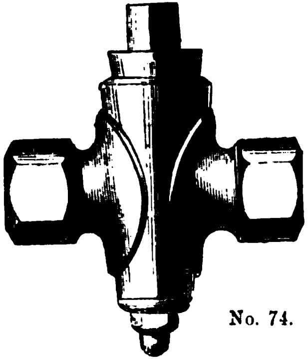

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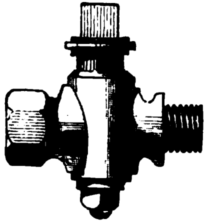

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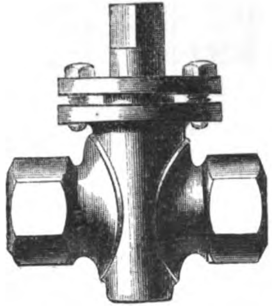

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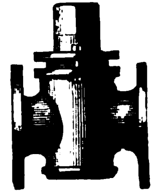

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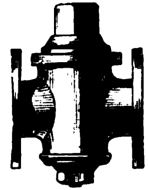
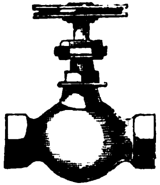


No. 78.

DIAMETER OF BORE	¼ in	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1¼ in.	1½ in.	2 in.	2½ in.	3 in.	4 in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
73. Plug Cock with flanges. Rough.	—	4 5	5 5	6 10	8 2	10 6	11 8	1 0 6	1 7 6	2 2 0	—	—	—
,, Ditto ditto Polished.	—	—	—	—	—	—	18 8	1 4 0	1 11 3	—	—	—	—
,, Ditto full-way Best.	—	—	9 0	—	15 0	—	1 1 6	1 7 6	1 16 0	2 17 6	3 18 0	5 2 0	8 8 0
74. Deep Barrel Plug Cock. London Pattern. Rough.	2 11	3 3	4 0	—	5 11	—	9 3	0 14 6	1 0 8	1 10 0	—	—	—
Deep Barrel Plug Cock. London Pattern. Polished	3 3	4 2	5 3	—	7 10	—	12 5	0 17 0	1 4 0	1 19 6	—	—	—
75. Plug Cock. London Pattern. Rough	2 6	2 9	3 7	—	5 5	—	8 6	0 12 9	0 19 3	1 8 3	—	—	—
,, Ditto ditto Polished.	3 0	3 7	4 5	—	6 10	—	10 10	0 16 3	1 2 3	1 16 3	—	—	—
,, Ditto Best, Rough.	3 0	3 11	4 9	—	6 11	—	11 5	0 16 3	1 1 0	1 16 0	3 0 0	—	—
,, Ditto ditto Polished.	3 4	4 2	5 1	—	7 6	—	12 7	0 18 0	1 3 7	2 1 0	3 6 0	—	—
76. Gland Cock with Bolts. London Pattern. Rough.	2 10	3 8	4 4	—	6 8	—	10 1	0 14 8	1 2 9	1 15 0	—	—	—
,, Ditto ditto Polished.	—	—	5 2	—	8 2	—	12 8	0 18 0	1 5 0	—	—	—	—
,, Ditto Best, Rough.	—	—	9 7	—	12 7	—	18 0	1 5 2	1 13 0	2 10 6	—	—	—
,, Ditto ditto Polished.	—	—	10 2	—	13 9	—	19 9	1 7 7	1 16 0	2 14 0	—	—	—
77. Iron Plug Cock, with flanges.	—	—	—	—	—	—	—	—	1 0 0	1 9 6	—	—	—
78. Iron Gland Cock, with flanges.	—	—	—	—	—	—	—	—	0 19 9	1 3 10	1 10 3	1 19 6	2 16 0
79. Screw Valve Cock. Rough.	—	3 8	4 8	5 5	6 8	—	9 5	0 12 3	0 16 3	1 7 3	—	—	—
,, Ditto Polished with Brass Wheels.	—	4 8	5 8	6 9	8 2	—	11 5	0 15 2	0 19 0	1 12 6	—	—	—
,, Ditto Best, Rough.	—	6 0	7 2	—	9 0	—	14 5	0 19 2	1 6 2	1 18 6	—	—	—
,, Ditto ditto Polished.	—	—	—	—	—	—	17 6	1 2 6	1 10 0	2 4 0	—	—	—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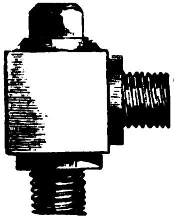
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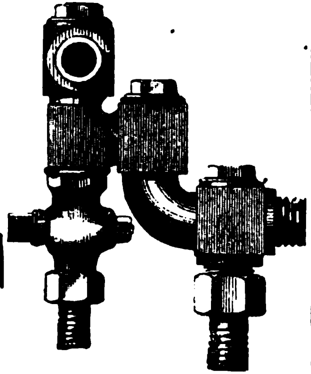
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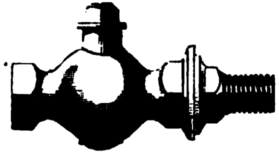
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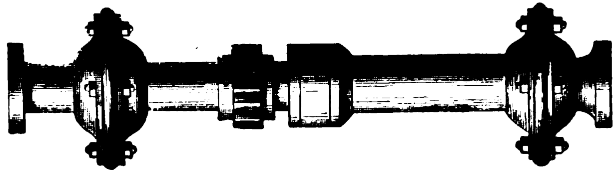
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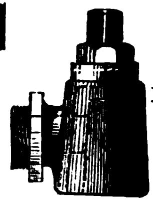
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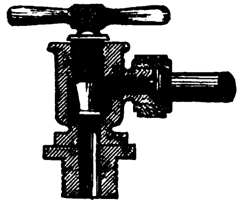
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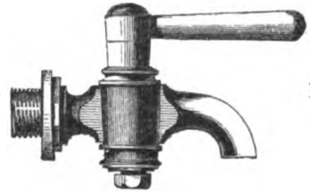
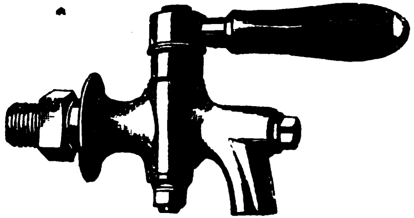

No. 89.

DIAMETER OF BORE	¼ in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1¼ in.	1½ in.	1¾ in.	2 in.	2½ in.	3 in.
	s. d.	s. d.	s. d.	s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.
80. Screw Valve Cock, same as 79, but with flanges	—	—	—	—	—	—	—	—	1 7 0	—	1 17 0	2 3 0	2 16 0
,, Ditto ditto BEST.	—	—	—	—	—	—	—	1 6 5	2 0 0	—	2 14 0	—	—
81. Square Valve Box, polished, with Ball, or Spindle Valves. . . .	—	—	5 5	6 4	0 7 3	8 2	0 8 6	0 12 9	15 3	—	1 2 9	—	—
82. Set of Treble Clack Boxes, polished.	—	—	—	—	1 6 4	—	1 16 0	2 8 9	—	—	—	—	—
83. Ball Clack and Cage (no woodcut) .	—	—	—	—	—	—	0 6 6	0 7 7	8 8	10 4	0 13 6	15 9	—
Clack Balls. . . . ditto . .	—	—	—	—		—	0 1 8	0 2 4	3 8	5 5	0 6 6	—	—
84. Pump Check Valve.	—	—	4 8	5 5	0 6 8	—	0 9 5	0 12 4	16 3	—	1 10 3	—	—
85. Screw Plug Cock.	—	—	—	—	0 6 4	—	0 10 0	0 13 9	19 3	—	1 6 0	—	—
86. Large blow-off Cock, with hollow plug and flanges (no woodcut). .	—	—	—	—	—	—	—	—					
87. Ball and Socket Pipes, polished at per lb.													
88. Screw Valve Gauge Cock, with union.	5 2	6 0	7 6	8 2	—	—	—	—	—	—	—	—	—
89. Deep Barrel Gauge Cock, full way	—	4 6	5 5	—	0 8 2	10 0	0 12 0	—	—	—	—	—	—



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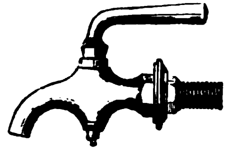

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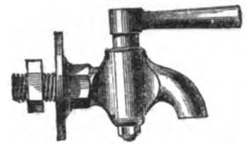

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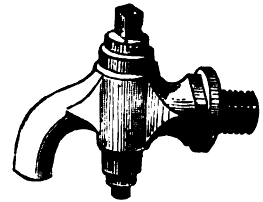

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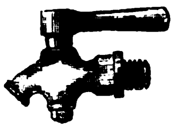

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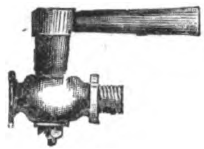

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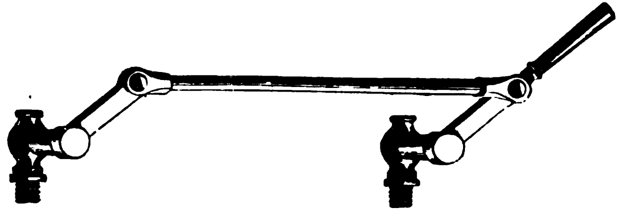

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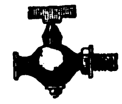
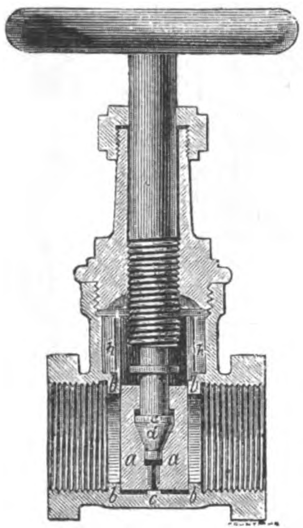


No. 98.

No. 99.

No. Diameter of Bore.	¼	⅜	½	⅝	¾	⅞	1	1¼	1½
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
89½. Gauge Cock, with cleansing Screw in front, back nut and G. M. Spanner, each	—	6 9	8 2	10 0	11 9	—	—	—	—
90. Globe Barrel Gauge Cock (no woodcut), each	3 0	3 3	4 2	4 9	5 5	—	6 6	8 8	—
91. Long Barrel Gauge Cock . . each	—	3 11	4 1	4 6	5 2	7 1	11 5	—	—
92. Deep Barrel Gauge Cock, with flange, each	—	—	7 1	—	9 0	—	14 6	—	—
93. Deep Barrel Gauge Cock, full way, extra strong . . . . each	—	—	5 9	6 9	8 6	—	11 8	16 3	20 6
94. Pet Cock . . . . each	3 0	3 10	4 1	—	—	—	—	—	—
95. Cylinder Cock . . . . each	1 10	2 0	2 9	—	—	—	—	—	—
96. Set of Portable Engine Cylinder Cocks, with brass rod and lever complete . . . . each	8 3	11 6		—	—	—	—	—	—
97. Plug Cock, deep barrel (no woodcut), each	—	2 9	3 3	—	5 2	—	8 2	—	—
98. Small Cylinder Cock, crutch handle, per dozen.	16 0	—	—	—	—	—	—	—	—
99. Small Pet Cock . . . per dozen.	18 0	—	—	—	—	—	—	—	—

No. 99a.

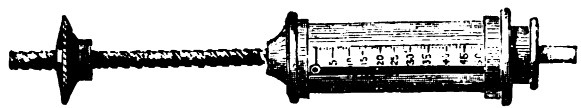


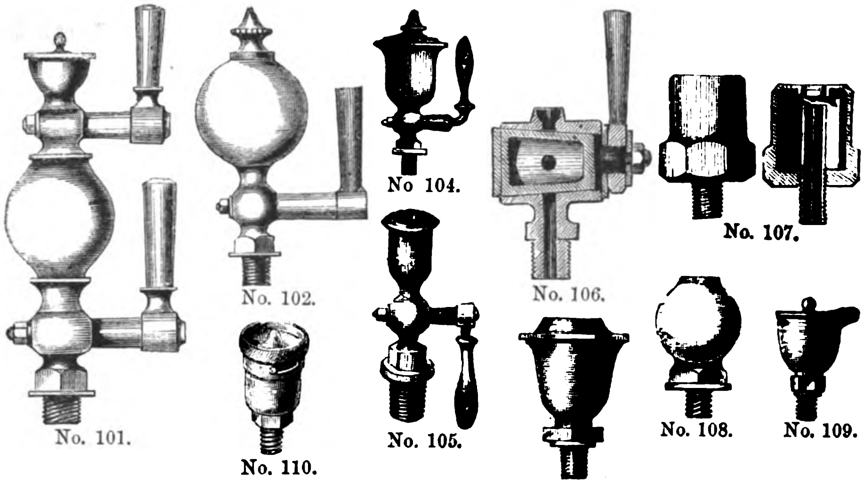
No. 99a. PEET'S PATENT GUN METAL VALVE COCKS (SCREWED ENDS, TESTED,) FOR STEAM, GAS, OR WATER.

Size	½	¾	1	1¼	1½	1¾	2	2½	3 Inch.
Price each . . .	5/9	8/2	11/10	15/8	20/0	26/6	31/0	62/6	87/6

Range.	2½	3	3½	4	5	6	7	8	9	10 in.
To indicate. lbs. lbs.	each. s. d.	each. s. d.	each. s. d.	each. s. d.	each. s. d	each. s. d.	each. s. d.	each. s d.	each. s. d.	each. s. d.
20 to 45	7 9	8 6	9 0	9 9	—	—	–	—	—	—
,, 50	8 6	9 0	9 9	10 3	16 9	18 8	—	—	—	—
,, 60	9 0	9 9	10 3	10 9	17 6	19 3	20 6	—	—	—
,, 70	9 9	10 3	10 9	11 4	18 0	19 9	21 8	23 0	—	—
,, 80	10 3	10 9	11 4	12 0	18 8	20 6	22 3	24 0	26 0	—
,, 100	11 4	12 0	12 8	13 3	19 3	21 8	23 4	25 4	27 0	29 0
,, 110	—	—	—	—	—	22 3	24 0	26 9	27 8	29 6
,, 120	—	—	—	—	—	23 4	25 3	27 0	28 9	30 9
,, 130	—	—	—	—	—	24 8	26 4	28 3	30 0	32 0
,, 140	—	—	—	—	—	25 9	27 8	29 4	31 3	33 0
,, 150	—	—	—	—	—	27 0	28 9	30 8	32 6	34 6

No. 100. SPRING BALANCES FOR LOCOMOTIVE AND PORTABLE ENGINES.





No. 101. No. 102. No 104. No. 105. No. 106. No. 107. No. 108. No. 109. No. 110. No. 111.

COMPOUND LUBRICATORS.

	1½	2	2½	3	3½	4	4½	5	in.
No. 101.	7/10	10/3	13/10	16/7	19/0	25/3	30/3	36/3	each.

COMMON LUBRICATORS.

	1¼	1½	2	2½	3	3½	4	4½	5	in.
No. 102. Globe pattern .		5/5	7/3	9/8	13/0	16/0	21/6	24/6	33/6	each.
,, 103. With hinge cover (no woodcut) .			10/0	12/6	13/10	18/3				,,
,, 104. Small pattern .	4/11	5/5	7/3							,,

GREASE COCKS.

	⅜	½	¾	1	1¼	1½	in.
No. 105. Grease Cock . .	5/3	5/9					each.
,, 106. Improved Hollow Plug Grease Cock . . .		7/3	9/7	14/6			,,

OIL CUPS.

	1	1¼	1½	1¾	2	2½	3	in.
No. 107. Syphon Oil Cup	22/0	23/0	25/0	28/6	36/0	50/0	65/0	per dozen.
,, 108. Ditto without cover . .	17/6	19/6	22/0	25/0	28/6	36/0	50/0	,,
,, 109. Ditto with hinged cover .	22/0	26/0	30/6	39/0	52/0			,,
,, 110. Ditto slot dish cover . .	22/0	26/0	30/6	39/0	52/0			,,
,, 111. Ditto spring cover . . .	15/6	20/0	25/0	28/6	36/0			,,
,, 112. Ditto for eccentric strap (no woodcut)		36/0	58/0		80/0			,,

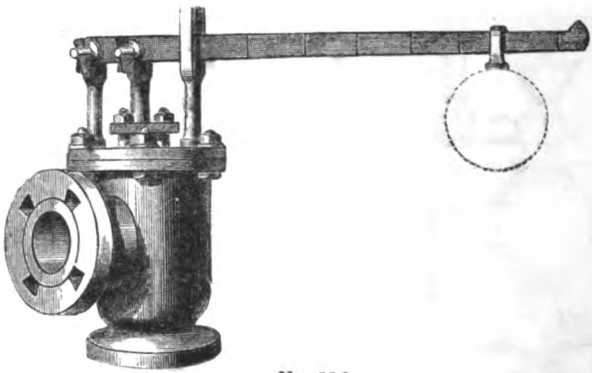
ROSCOE'S PATENT SELF-ACTING LUBRICATORS.

No. 1. For agricultural and small Engines, or Steam Hammers	1	15	0
,, 2. For Engines up to 30 horse power, or for outside Cylinder Locomotives . .	3	0	0
,, 3. For ordinary Locomotives and Engines up to 50 horse power	4	10	0
,, 4. For extra powerful Locomotives and for Engines up to 50 horse power . .	5	10	0

LIEUVAIN'S PATENT SELF-ACTING NEEDLE LUBRICATORS FOR SHAFTING.

Nos. 1. 2. 3. 4. 5. Price 15/0 per dozen.
,, large size. ,, 30/0 ,,

No. 114.



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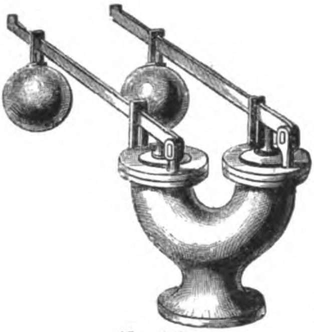

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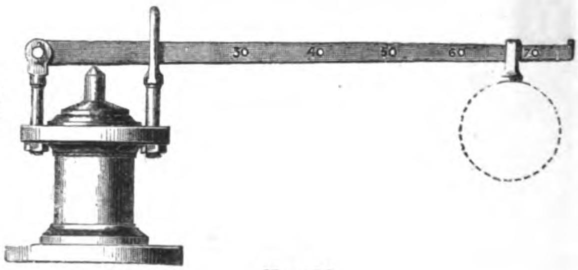

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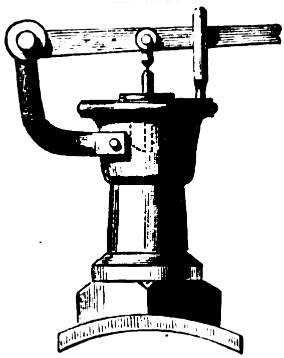

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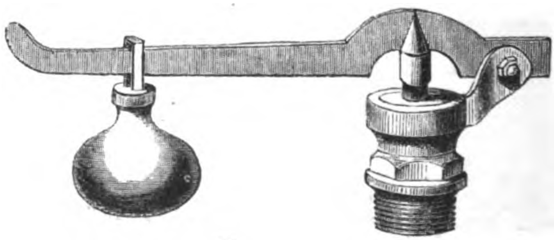


No. 120.

STEAM WHISTLES.

		1¼	1½	2	2½	3	3½	4 inches
No. 113.	Steam Whistle (no woodcut)	,,	8/9	13/0	17/0	20/6	34/0	46/6 each.
No. 114.	Small ditto for portable engines,	7/10	8/9	13/0	17/0 each.			

No. 115. Steam Hummer, 6 inches, 65/0. (Similar pattern to No. 114, but larger.)

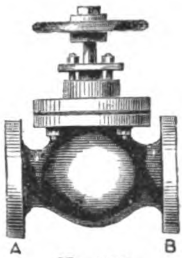
SAFETY VALVES FOR STEAM BOILERS.

No. 116. Lever Safety Valve at 20/6 per inch diameter of valve.
No. 117. Double Safety Valve with levers and balls complete, at 21/9 per inch.
No. 118. Iron Safety Valve with ditto, ditto, 16/3 per inch.
No. 119. Ditto ditto ditto, 19/6 ,,
No. 120. Gun Metal Safety Valve with lever and weights,

¾	1	1¼	1½	2 inches.
9/9	12/0	15/0	18/0	23/10 each.

No. 121. Brass Lock-up Safety Valve with iron flange for portable engines (no woodcut),

1½	2 inches.
27/0	30/0 each.



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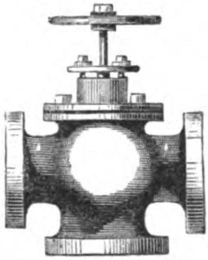
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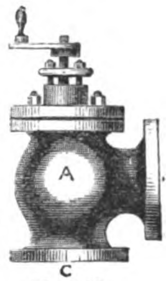

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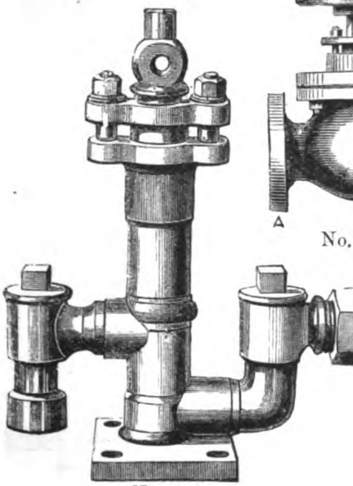
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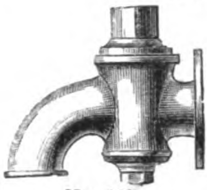
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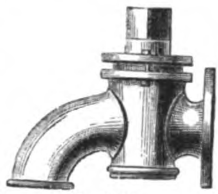

No. 128.

IRON JUNCTION VALVES,

With gun-metal valves and seats.

	Bore	2	2½	3	3½	4	5	6	7	8	10 in.	
No. 122.	Price	27/0	32/6	43/6	54/0	65/0	89/6	110/0	132/0	162/0	...	each.
Ditto,	BEST	32/6	45/6	57/6	...	84/0	108/0	132/0	...	173/0	240/0	,,
No. 123.		...	43/6	65/0	...	87/0	108/0	130/0	...	...	...	,,
Ditto,	BEST	40/0	54/0	67/0	...	98/6	122/6	156/0	...	200/0	290/0	,,

No. 124. Iron Bib Valve (no woodcut), same prices as No. 122.

No. 125. ANGLE VALVE.

	Bore.	2	2½	3	4	5	6	7	8	10 in.	
	Price.	27/0	32/6	43/6	65/0	89/6	110/0	132/0	162/0	...	each.
Ditto,	BEST	33/6	45/6	57/6	84/0	108/0	132/0	...	173/0	240/0	,,

IRON VALVE COCKS, with brass stop and seat.

		1½	2	2½	3	4 in.	
No. 126.	(Same pattern as No. 79.) . .	22/9	27/0	32/6	43/6	...	each.
,, 127.	Iron Bib Plug Cock	11/0	13/9	22/9	32/6	52/6	,,
,, 128.	Iron Gland Bib Cock . . .	22/0	25/6	33/6	43/6	62/0	,,

No. 128A. IRON JUNCTION VALVE, LEVER SAFETY VALVE, and DEAD WEIGHTED SAFETY VALVE COMBINED.

Cast-Iron Branch Pipe to hold the above Valves, at 9*s.* per inch.

Lever Safety Valves. *See* No. 118.

Iron Junction Valves. *See* Nos. 123 & 125.

Dead Weighted Safety Valves,	2	2½	3	3½	4 in.
Each	£5	£6 10s.	£8 10*s.*	£10 10*s.*	£12 10*s.*

No. 128B. EQUILIBRIUM VALVES.

Price at £3 3*s.* per inch diameter of outlet pipe.

No. 129. PLUNGER FEED PUMP, screwed for iron pipe.

Diameter of Ram .	¾	1	1½	2	2¼	in.
In Brass .	50/0	63/0	75 0	100/0	...	each.
In Iron .	...	...	75/0	88/0	100/0	,,

129A. CAST-IRON FEED PUMP, mounted on stout plank.

With gun metal suction and delivery valves screwed for iron tube, wrought iron handle and sling, guide rod, &c. complete.

Diameter of Ram	1¾	2	2¼	2½	in.
Price	£5 12*s*. 6*d*.	£6 12*s*. 6*d*.	£7 10*s*.		

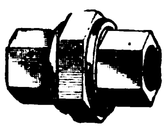

No. 130.

No. 130. CONNECTING VALVE, for Iron Pipe.

½	¾	1	1¼	in.
3/0	4/1	5/0	6/0	each.

No. 131. STEAM UNION JOINTS. (No woodcut.)

¼	⅜	½	¾	1	1¼	1½	2	in.
2/2	2/9	3/3	4/0	5/2	7/1	9/7	18/0	each.


No. 132.


No. 133.

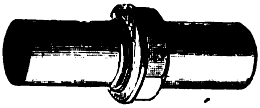
GUN-METAL CONE UNION JOINTS FOR IRON TUBE,

Screwed each end.

	Diameter.	¼	⅜	½	¾	1	1¼	1½	2	in.
No. 132.	Price	2/4	2/6	3/2	4/5	5/8	8/2	10/8	15/8	each.
,, 133.	,,	2/2	2/6	3/2	4/5	5/8	8/2	10/8	15/8	,,

No. 134 GUN METAL STEAM UNION JOINT, one end screwed, other end for solder, or ribbed for hose. (No woodcut.)

Diameter.	¼	⅜	½	¾	1	1¼	1½	2	in.
Price.	1/7	1/11	2/4	3/6	4/9	6/10	9/5	13/3	each.

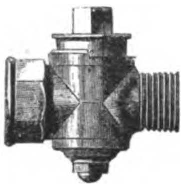


No. 135.
STRONG BRASS UNION JOINTS,
For Soldering.

Diameter	¼	⅜	½	⅝	¾	⅞	1	1¼	1½	1¾	2	2½	3	in.
Price	0/11	1/1	1/5	1/10	2/10	3/5	4/1	5/7	6/6	9/4	10/11	14/4	18/0	each.

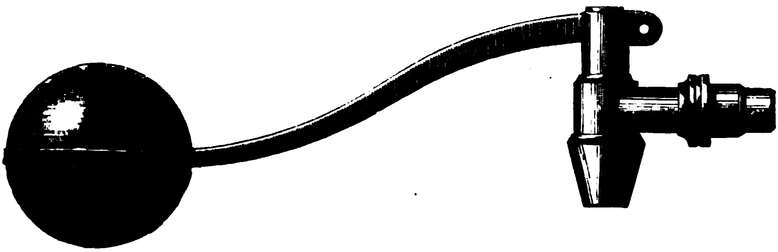
No. 136.—BRASS BARREL UNIONS, similar pattern to 135, but shorter, and screwed (inside) for iron pipe.

Diameter	¼	⅜	½	¾	1	1¼	1½	2	in.
Price	0/10	1/1	1/3	1/8	2/6	4/4	5/8	—	each.
Strong ditto	0/11	1/2	1/6	1/11	2/10	5/0	6/10	12/0	,,



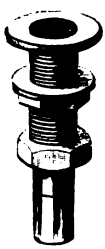
No. 137.—BRASS MAIN COCKS, male and female ends, screwed for iron pipe.

Diameter	⅜	½	¾	1	1¼	1½	2	in.
Price	1/7	1/11	2/2	5/0	—	—	—	each.
Strong ditto	1/10	2/2	3/2	6/3	12/6	15/7	31/6	,,



No. 138.—EQUILIBRIUM BALL VALVES, with Copper Balls.

Diameter	⅜	½	⅝	¾	⅞	1	1¼	1½	2	in.
With Shanks for Solder	3/5	3/11	4/7	5/5	8/9	10/8	16/10	25/0	50/0	each.
,, Shanks screwed for Pipe	3/9	4/3	5/0	5/10	9/8	11/7	18/1	27/0	54/6	,,
,, Screw Bosses	4/1	4/7	5/5	6/5	10/0	12/6	19/4	28/9	59/0	,,



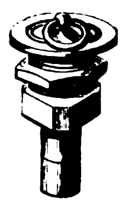
No. 139.

No. 139.—SLATE CISTERN CONNECTIONS, with Fly Nuts and Unions.

Diameter	½	¾	1	1¼	1½	2	in.
Price	3/2	3/9	5/0	6/3	8/1	9/6	each.

No. 140.—BASIN WASHERS AND PLUGS, with Fly Nuts, and Union Connections for Solder.

4/1 each.

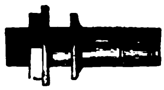


No. 140.

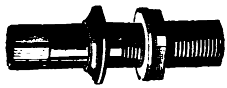
No. 141.—DITTO, without Union Connections, 3/2 each.
Brass Chains 7½*d.* per yard.

No. 142.—COMMON WASHERS and PLUGS.

Diameter	½	¾	1	1¼	1½	2	in.
Price	1/3	1/8	2/1	2/11	3/5	5/8	each.
Extra Long Shanks	1/4	1/10	2/4	3/2	3/9	6/0	,,



No. 143.



No. 144.

No. 143.—BOILER SCREWS, with Back Nuts, for Solder.

Diameter	½	⅝	¾	⅞	1	1¼	1½	2	in.
Price	1/3	1/7	1/10	2/2	2/10	3/6	4/10	8/2	each.

No. 144.—SLATE CISTERN SCREWS, with Back Nuts, for Solder.

Diameter	½	⅝	¾	⅞	1	1¼	1½	in.
Price	1/8	1/10	2/4	2/10	3/6	4/8	6/0	each.

No. 145.—YELLOW METAL RANGE COCKS, Screw Shanks and Nuts, Square Heads, and Brass Spanners.

Diameter	½	⅝	¾	⅞	in.
Rivet Bottom	3/2	4/5	—	—	each.
Screw Bottom	4/1	5/4	6/6	8/9	,,

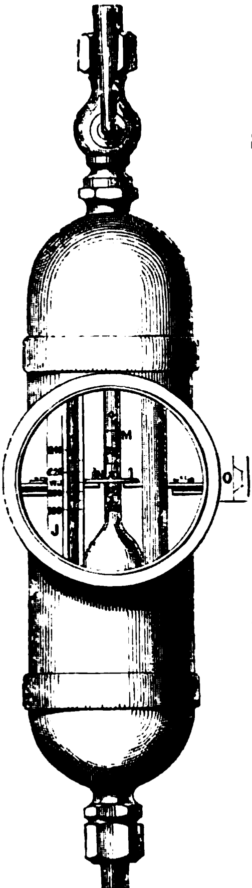
No. 146.—BEST STRONG RANGE COCKS, Screw Shanks and Nuts, Square Heads, Screw Bottoms, Brass Spanners.

Diameter	⅜	½	⅝	¾	⅞	1	in.
Price	4/5	5/8	6/6	7/10	10/6	13/0	each.

No. 147.—STOP COCKS, and BIB COCKS, Crutch Keys and Round Shanks for Soldering.

Diameter	⅜	½	⅝	¾	⅞	1	1¼	1½	2	in.
Rivet Bottom	2/2	2/9	3/2	3/9	5/8	7/2	10/8	13/2	31/0	each.
Screw Bottom	2/6	3/2	3/7	4/5	6/6	8/6	11/10	15/0	34/6	,,

If Screwed one end for Iron Pipe, about 10 per cent. more.



ELEVATION

(No. 1.)
SAUNDERS' PATENT SALINOMETER OR SALT WATER GAUGE

Is a simple, efficient, self-acting instrument for showing the density of the water in marine or other boilers, where the water used is salt, brackish, or contains other impurities, such as lime, silica, &c. &c.

Each Salinometer is complete with hydrometer, and thermometer.

Price complete with hydrometer and thermometer, £8 8s.

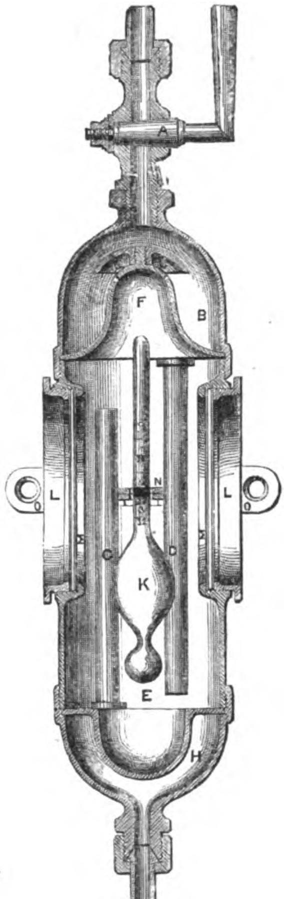
Spare articles if required.

Thermometers, Fahrenheit, or Centigrade, each 7/6.

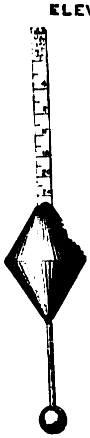
Hydrometers, each 6/0

Glass faces, each 1/0.

India rubber packing rings for ditto, per dozen, 1/0.



SECTION



No. 3.

No. 3. IMPROVED SALINOMETER, silvered, and gauge-marked. Price, in japanned tin case, 25/0 each.

No. 4. GLASS SALINOMETERS, 5/6 each.

,, GILT METAL DITTO, 25/0 each.

,, DITTO with thermometer, in mahogany box, 36/6 each.

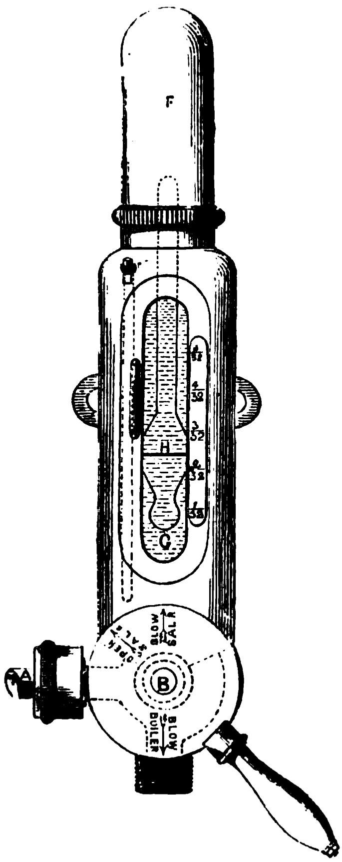
No. 5. HOW'S PATENT SALINOMETER, £8 8s.

No. 6.

GAMBLE'S PATENT STEAM LUBRICATORS.

For lubricating the steam which passes into the slide valves and cylinders, and for preventing waste of lubricating material in Steam Engines.

	½ pint.	1 pint.	2 pints.	3 pints.
Each	£2 15*s.* 0*d.*	£3 17*s.* 0*d.*	£4 5*s.* 0*d.*	£4 15*s.* 0*d.*



No. 7.

GAMBLE'S PATENT SALINOMETER.

The advantages claimed by the Patentee are, that its action is continuous, like that of a steam or vacuum gauge, and the engineer in charge can see at a glance the density of the water contained in the boilers, without an escape of steam or boiling water, the indications being given outside the face of the instrument.

The hydrometer and thermometer cannot be broken as they are placed within the case.

One cock only is required, and it is arranged with different openings, so that each operation necessary for working the Salinometer can be performed by changing the position of the handle.

Price, with cock complete . . . . £8 8*s.* 0*d.*

PATENT ANTI-FRICTION METAL

THIS Metal in many kinds of Bearings has been found more durable than Gun Metal, and in addition to being lower in first cost, the Bearings *require neither boring nor fitting.*

The mode of making these Bearings is as follows,—Suspend the shaft in its working position; stop the ends of the bearing holders with clay or putty, so as to form a mould, melt the Metal in a ladle, pour it into its place, and when cool it is ready for work.

Price, 10*d.* per lb. net, varying with the prices of metals.

Levett's Patent Anti-attrition Metal, Whitley's Patent Anti-friction Metal, Babbit's, Dewrance's, and other similar metals are about the same price, and may be used in the same way.

BELLS.

FACTORY, House, Fire, or Alarm Bells, in wrought-iron frame to fix against the wall of a house; the axis passing through the wall, the bell may be rung from the inside.

Frame for	6	7	8	9	10	11	12	13	14 in. Bell.
Price	24/0	27/0	33/0	35/0	40/0	50/0	55/0	68/0	75/0 each.

Table of SIZES and WEIGHTS of single bells—weights subject to slight variations.

Diam. of Bell.	Approximate weight of Bell		Diam. of Bell.	Approximate weight.			Diam. of Bell.	Approximate weight.			Diam. of Bell.	Approximate weight.		
Inches.	qrs.	lbs.	Inches.	cwt.	qrs.	lbs.	Inches.	cwt.	qrs.	lbs.	Inches.	cwt.	qrs.	lbs.
6	0	4½	14	0	2	20	22	2	2	6	30	5	2	22
7	0	6½	15	0	3	16	23	2	3	0	31	6	1	0
8	0	11	16	1	0	12	24	3	0	0	32	6	3	0
9	0	16	17	1	1	4	25	3	2	3	33	7	2	5
10	0	22	18	1	2	0	26	4	0	0	34	7	3	20
11	1	4	19	1	3	0	27	4	2	20	35	8	2	15
12	1	20	20	2	0	0	28	4	3	8	36	9	0	0
13	2	6	21	2	1	0	29	5	2	0	37	9	2	0

Usual price about 1/8 per lb. varying with the prices of metal.

HAND BELLS,

FOR RAILWAY, MARINE, AND OTHER PURPOSES.

Diameter of Bells . .	3	3½	4	4½	5	6	7	8	9	Inch.
Plain Cast	3/0	4/0	4/6	6/0	7/6	9/0	16/6	23/0	35/0	each.
Turned Edges . . .	3/3	4/9	5/3	6/9	8/3	10/6	17/6	25/6	39/0	,,
Polished Bright . .	4/6	5/0	6/0	7/6	9/6	12/0	21/6	30/0	44/0	,,

LAP-WELDED STEAM TUBES, SCREWED AND SOCKETTED.

Internal Diameter. Inches.	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½
Thickness. Birmingham Wire Gauge.	9	9	8	8	8	8	7	7	7	7	7	6	6
,, Whitworth's Decimal Gauge.	150	150	165	165	165	165	180	180	180	180	180	200	200
Approximate Weight per foot in lbs.	2.65	3.17	3.69	4.15	4.75	5.25	6.20	6.70	7.20	7.68	8.12	9.50	10.20
Price per foot Lineal	s. d. 1 4	s. d. 1 7	s. d. 1 10	s. d. 2 1	s. d. 2 5	s. d. 2 9	s. d. 3 1	s. d. 3 4	s. d. 3 7	s. d. 3 10	s. d. 4 1	s. d. 4 7	s. d. 5 0

Internal Diameter. Inches.	4¾	5	5¼	5½	5¾	6	6¼	6½	6¾	7	7¼	7½	8
Thickness. Birmingham Wire Gauge.	6	6	5	5	5	5	4	4	4	¼ in.	¼ in.	¼ in.	¼ in.
,, Whitworth's Decimal Gauge.	200	200	220	220	220	220	240	240	240	250	250	250	250
Approximate Weight per foot in lbs.	10.75	11.33	12.74	13.10	13.52	14.00	16.15	16.72	17.43	19.75	20.50	21.24	24.37
Price per foot Lineal	s. d. 5 4	s. d. 5 9	s. d. 6 2	s. d. 6 6	s. d. 6 11	s. d. 7 5	s. d. 8 0	8 0					

PATENT LAP-WELDED IRON BOILER TUBES, ENDS PLAIN.

External Diameter in Inches.	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6
Birmingham Wire Gauge.	14	14	14	13	13	13	12	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	7
Whitworth's Decimal Guage in 1000ths of an Inch.	85	85	85	95	95	95	110	110	110	120	120	120	135	135	135	150	150	150	165	165	165	180	180	180
Price per foot up to 16 ft. long	d. 7½	d. 7¾	d. 8	d. 8¼	d. 8½	d. 9	d. 10	d. 10½	d. 11	s. d. 1 0	s. d. 1 1	s. d. 1 3	s. d. 1 5	s. d. 1 8	s. d. 2 0	s. d. 2 3	s. d. 2 9	s. d. 3 0	s. d. 3 3	s. d. 3 6	s. d. 3 9	s. d. 4 0	s. d. 4 6	s. d. 5 0

DISCOUNTS.	B.B. Quality........................	Improved	Charcoal Iron ....

HOMOGENEOUS METAL TUBES. NETT.

External Diameter in Inches.	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2½	2¾	3
Birmingham Wire Gauge.	14	14	14	14	14	14	14	13	13	12	12	11
Whitworth's Decimal Guage in 1000ths of an Inch.	85	85	85	85	85	85	85	95	95	110	110	120
Price per foot up to 16 ft. long.	d. 7½	d. 8½	d. 9	d. 10	d. 11	s. d. 1 0	s. d. 1 1	s. d. 1 3	s. d. 1 5	s. d. 1 7	s. d. 1 9	s. d. 2 0

External Diameter in Inches.	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6
Birmingham Wire Gauge.	11	10	10	10	10	10	10	10	9	9	9	9
Whitworth's Decimal Guage in 1000ths of an Inch.	120	135	135	135	135	135	135	135	150	150	150	150
Price per foot up to 16 ft. long.	s. d. 2 3	s. d. 2 9	s. d. 3 3	s. d. 3 6	s. d. 4 0	s. d. 4 3	s. d. 4 6	s. d. 4 9	s. d. 5 0	s. d. 5 3	s. d. 5 6	s. d. 6 0

Intermediate Diameters will be charged at the next higher rate. Variations from List Gauges, by Special Quotations.

BOILER TUBE FERRULES. NETT.

External Diameter of Ferrule at largest end in Inches.	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾
Price, Iron per 1000.	s. 100	100	s. 105	s. 110	s. 120	s. 130	s. 140	s. 150	s. 160	s. 170	s. 180
Ditto, Steel per 1000.	135	135	135	145	155	170	180	190	200	210	225

External Diameter of Ferrule at largest end in Inches.	2⅞	3	3⅛	3¼	3⅜	3½	3⅝	3¾	3⅞	4
Price, Iron per 1000.	s. 190	s. 205	s. 220	s. 235	s. 250	s. 265	s. 280	s. 295	s. 330	s. 345
Ditto, Steel per 1000.	240	255	275	295	310	330	345	365	400	430

Hydraulic Tubes are made any size or thickness to order, 5½*d.* per lb.

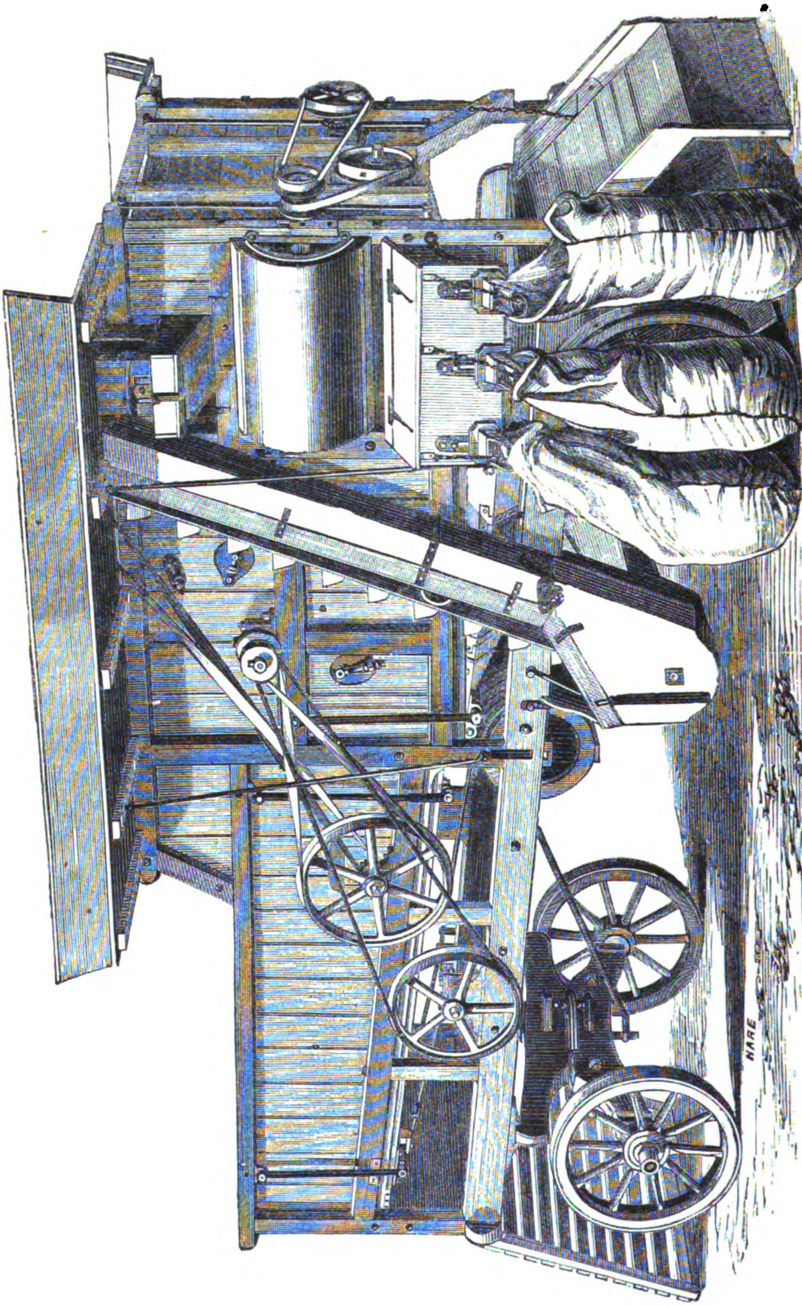
COLONIAL, AGRICULTURAL,

AND

MANUFACTURING PLANT

AND

MACHINERY.



CLASS A.—STEAM THRASHING AND FINISHING MACHINE, FOR SEPARATING THE THIN CORN FROM THE BEST, AND PREPARING THE SEPARATE SAMPLES FOR MARKET.

STEAM-POWER THRASHING MACHINERY.

THE Machines are of two kinds: the "Class A" Machines are complete with FINISHING APPARATUS for cleaning and screening the corn, and separating the different sizes of grain, so that they are ready for market. The "Class B" Machines dress the corn sufficiently well for many localities, and take less power than the "A" Machines, and they are made so that finishing apparatus can be added at any future time at a cost shown by the difference in the prices of the two classes. Each machine is supplied with a waterproof cover and a set of screw-keys. EXTRA DRUMS for thrashing rice or rape-seed are supplied, if required.

FOR EXPORT it is recommended that each machine should be supplied with a set of spare working parts, *i.e.*, 2 pairs of drum-shaft brasses, 2 pairs of shaker-shaft brasses, 2 pairs of hummeller-shaft brasses, 1 pair of blower-shaft brasses, 1 set of small driving straps, 1 sheet of smutter wire, 1 set of patent beaters for drum, and 1 extra driving belt. All the machines are mounted on wood travelling-wheels, with fore-carriage and shafts for horses or oxen.

CLASS A.—MACHINES FOR THRASHING AND FINISHING FOR MARKET.

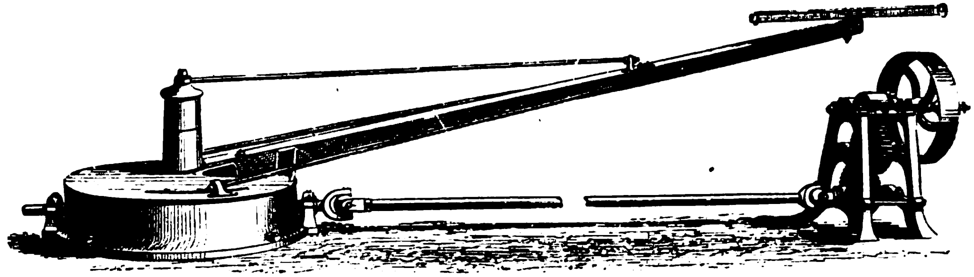
Size of Machine	A 1	A 2	A 3	A 4
Size of Engine required	5 H. P.	6	7 or 8	9 or 10
Width of Thrashing Drum	4 ft.	4 ft.	4 ft. 6 in.	ft.
Will thrash, average of 10 hours Bushels	400 to 500	500 to 600	600 to 800	700 to 900
Price of Machine	£92	£108	£115	£125
Cost of Packing for Export	£6	£7	£8 10s.	£9 10s.
Weight with Packing Case	52 cwt.	64 cwt.	75 cwt.	81 cwt.
Measurement with ditto. cub. ft.	449	630	688	745

CLASS B.—MACHINES FOR THRASHING AND DRESSING.

Size of Machine	B 0	B 1	B 2	B 3	B 4.
Size of Engine required	3 H. P.	4 or 5	6	7 or 8	9 or 10
Width of Thrashing Drum	3 ft. 6 in.	4 ft.	4 ft.	4 ft. 6 in.	5 ft.
Will thrash, average of 10 hours Bushels	300 to 400	450 to 550	550 to 650	650 to 850	750 to 950
Price of Machine	£68	£85	£100	£105	£115
Cost of Packing for Export	£5	£6	£7	£8 10s.	£9 10s.
Weight, with Packing Case	40 cwt.	48 cwt.	64 cwt.	75 cwt.	81 cwt.
Measurement, with ditto. cub. ft.	375	430	630	688	745

CLASS C.—HORSE-POWER THRASHING MACHINES AND WINNOWING MACHINES FOR HORSES, BULLOCKS, OR MULES.

Size of Machine	C 2	C 3	C 4	C 5
Power required	2 Horses.	3 Horses.	4 Horses.	5 Horses.
Width of Drum	18 in.	24 in.	27 in.	36 in.
Will thrash average bushels per hour	14 to 16	32 to 36	40 to 45	50 to 55.
	£ s.	£ s.	£ s.	£ s.
Prices for Horse Gear	13 10	23 0	29 0	36 0
„ Intermediate Motion	5 5	5 10	6 10	7 0
„ Pullies on ditto	2 0	2 0	2 5	2 5
„ Driving Strap from ditto to Barn works	1 15	2 0	3 0	3 15
„ Barn works	14 10	17 0	20 10	26 0
„ Dressing Machine, with connecting strap to Thrashing Machine as well as handles	11 10	11 10	11 10	11 10
Price for the set complete	£48 10	£61 0	£72 15	£86 10
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Price for 4 Wheeled Carriage	18 0 0	20 0 0	25 10 0	28 0 0
„ Extra Working Parts for Export	2 0 0	4 6 6	5 10 6	5 10 6
„ Packing for Export	3 0 0	4 0 0	5 0 0	5 0 0



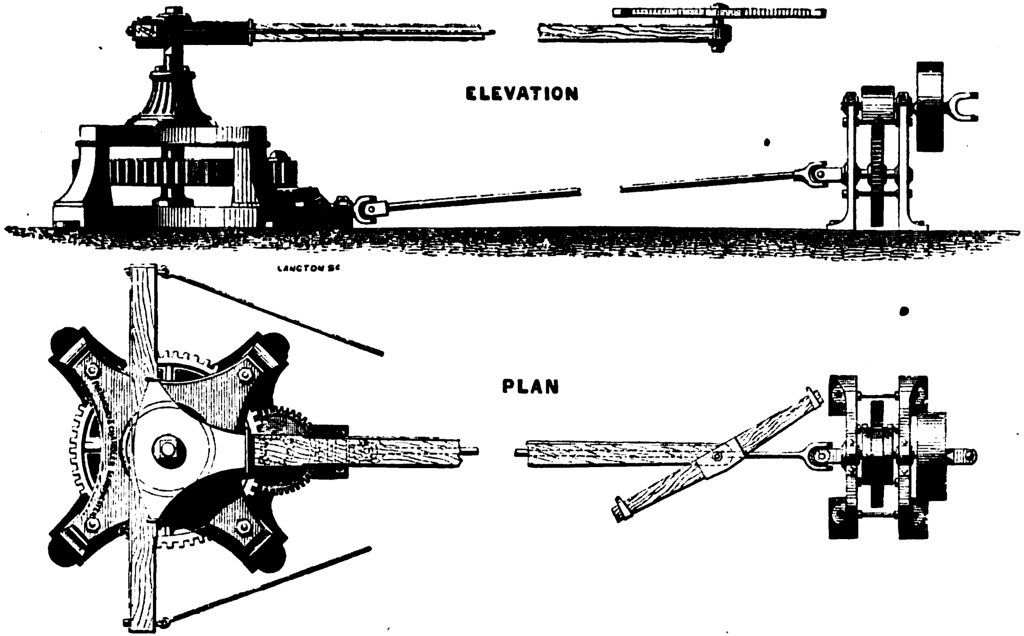
HORSE GEARS FOR WORKING PUMPS, CHAFF CUTTERS, &c.

In the construction of these Gears special regard has been paid to simplicity of construction, lightness of draught, compactness and great strength. The whole of the shafts are turned true to their bearings, and fitted throughout with gun metal steps; the working parts are all encased so as to protect them from dirt and dust, and the bearings are easy of access for oiling.

One Horse Gear complete, with intermediate motion, as shown, £11 10*s.* 0*d.* Weight, including poles and intermediate motion, about 8½ cwt. Measurement, 54 cubic feet. Pulley extra in proportion to size.

EXTRA STRONG HORSE GEARS.

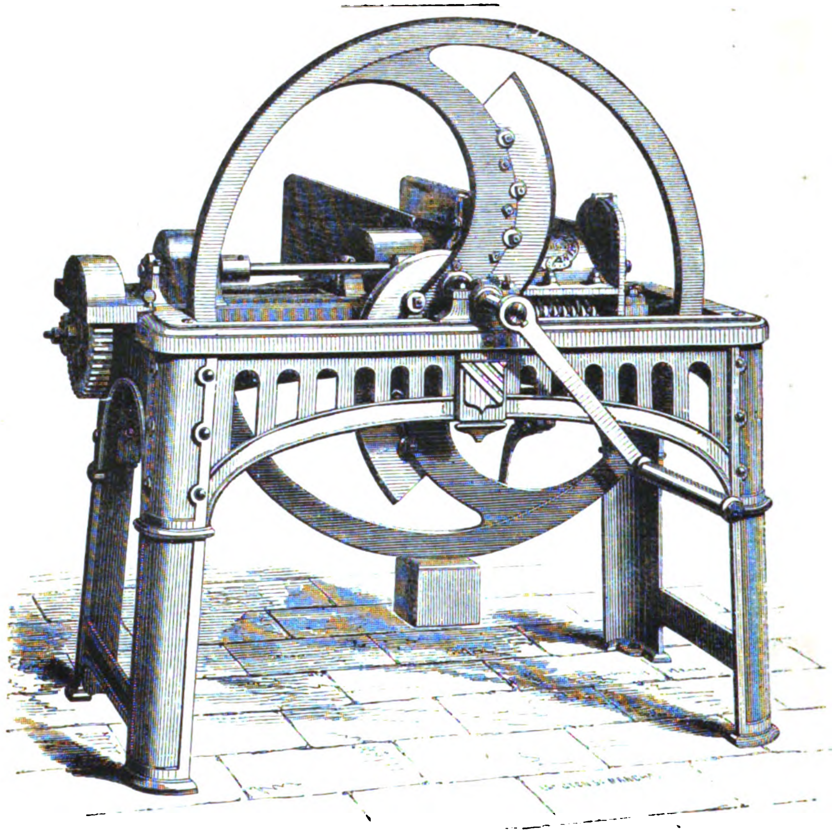
The Horse Gears illustrated at p. 317. are made for driving a heavier class of Machinery than those described above. The first motion is obtained from a spur wheel and pinion, instead of bevil gear, for the purpose of obtaining light draught. The drawing shafts are trussed with adjustable iron rods, and the whole of the shafts run in gun metal bearings. The subjoined prices include intermediate motion with the wheels, encased joints, and shafts. Pulleys are supplied at an extra charge in proportion to the size required.



EXTRA STRONG HORSE GEARS.

For descriptions, see p. 316.

	£	s.	d.		
One-Horse power Gears . .	14	0	0	Weight about $12\frac{1}{2}$ Cwt.	Measurement about 74 cubic ft.
Two " " "	16	0	0	ditto " 13 "	ditto " 74 "
Four " " "	23	10	0	ditto " 1 Ton	ditto " 74 "



CHAFF CUTTERS.

The Machines illustrated are constructed entirely of iron, and are therefore available for use in all climates. Every part is made to gauge or template, so that duplicates of any part can be supplied ready to put into place; the great advantage of this systematized mode of production will be appreciated by all who have had to do repairs in localities where skilled labour is scarce. The principal bearings are in gun metal, and the four largest sizes have double feeding rollers, steel mouth pieces, and stop motions for instantly arresting the feed, and the length of the cut is varied by means of the Change Wheels.

The smaller sizes are suitable for private establishments where one or two horses are kept, and the larger ones for large farms, contractors, brewers, cab, omnibus, or van owners and railway companies, as well as for cutting straw for paper mills, &c.

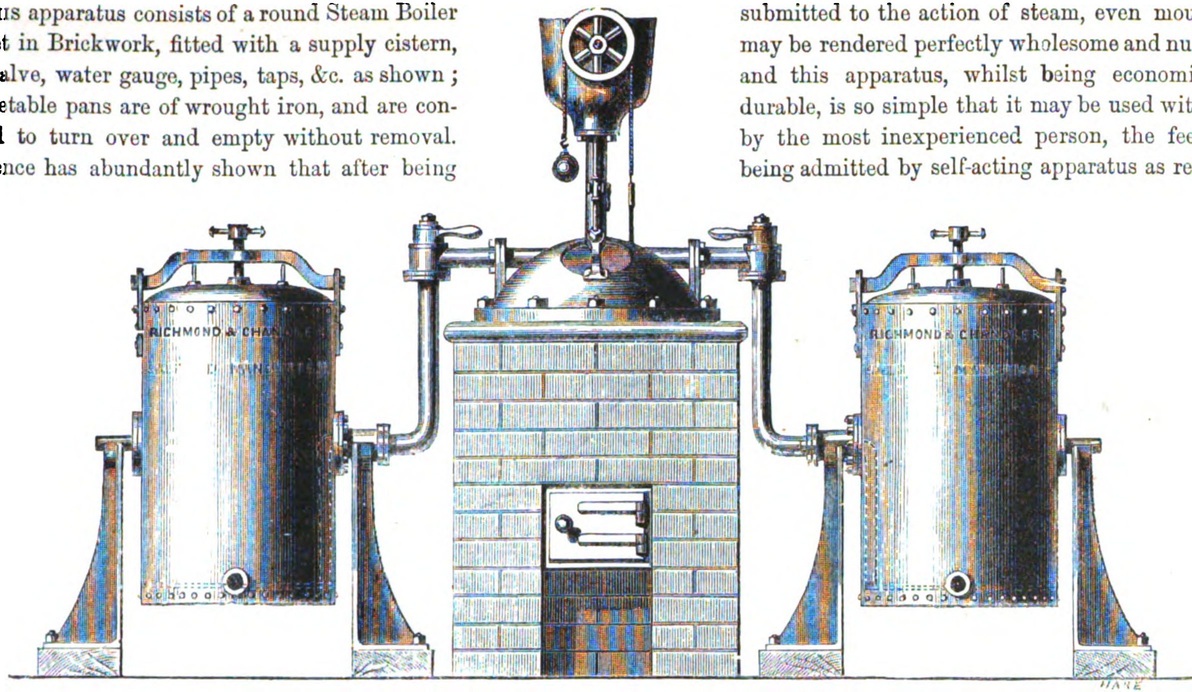
No.	Price.	Will cut per hour.	Cost of Knives.	Cost of Pulleys.	Cost of Change Wheels, per set.	Cost of Packing.	Approximate Weight.	Approximate Measurement.
	£ s. d.		s. d.	s. d.	s. d.	s. d.	cwt.	cubic ft.
1	2 10 0	150 lbs.	3 6 each.			†	1½	
2	3 15 0	170 ,,	4 6 ,,			†	2¼	
3	4 0 0	200 ,,	4 6 ,,			10 0 each.	2½	15
4	5 0 0	224 ,,	4 6 ,,	9 0 each.		11 0 ,,	2¾	12
5	5 15 0	300 ,, *	4 6 ,,	11 0 ,,	4 6	15 0 ,,	3¼	18
6	7 7 0	430 ,, *	5 0 ,,	12 0 ,,	6 0	20 0 ,,	4	31
7	10 10 0	1½ tons. *	7 6 ,,	13 0 ,,	6 0	25 0 ,,	6	32
8	16 16 0	1¾ ,, *	7 6 ,,	16 0 ,,	6 0	25 0 ,,	10	32
9	21 0 0	2 ,, *	8 6 ,,	19 0 ,,	7 0	30 0 ,,	12	43

*** If worked by steam No. 5 will cut 10 cwt. per hour, and No. 6, 1 ton. Nos. 7, 8, and 9 are adapted to work by power only.**

† Nos. 1 and 2 are rarely packed singly, and the cost of packing six No. 1 machines is £1 10*s*.; and the cost of packing six No. 2 machines is £2 7*s*. 6*d*.

The Authors have constructed very powerful machines adapted for cutting straw or esparto grass for paper makers, cane top cutting, &c.: but as these are almost invariably made to suit some special arrangement of machinery, any quotation of prices would almost necessarily be erroneous.

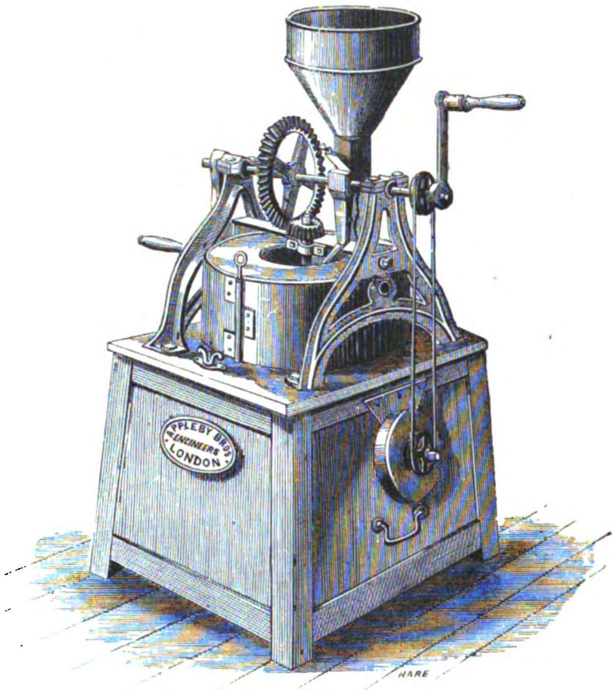
STEAMING APPARATUS WITH TWO PANS.



This apparatus consists of a round Steam Boiler to be set in Brickwork, fitted with a supply cistern, safety valve, water gauge, pipes, taps, &c. as shown; the vegetable pans are of wrought iron, and are constructed to turn over and empty without removal. Experience has abundantly shown that after being submitted to the action of steam, even mouldy hay may be rendered perfectly wholesome and nutritious; and this apparatus, whilst being economical and durable, is so simple that it may be used with safety by the most inexperienced person, the feed water being admitted by self-acting apparatus as required.

100 Gallon Boiler, with two 8 bushel vegetable pans complete	£16	3	0
80 ,, ,, two 8 ,, ,, ,, ,, . .	15	3	0
60 ,, ,, two 6 ,, ,, ,, ,, . .	12	8	0
40 Gallon Boiler with one 5 bushel vegetable pan complete .	£7	4	0
30 ,, ,, one 4 ,, ,, ,, . .	6	9	0

The 30 and 40 Gallon Boilers with Pan one Bushel larger 5s. extra.



IMPROVED PORTABLE CORN-GRINDING MILLS,

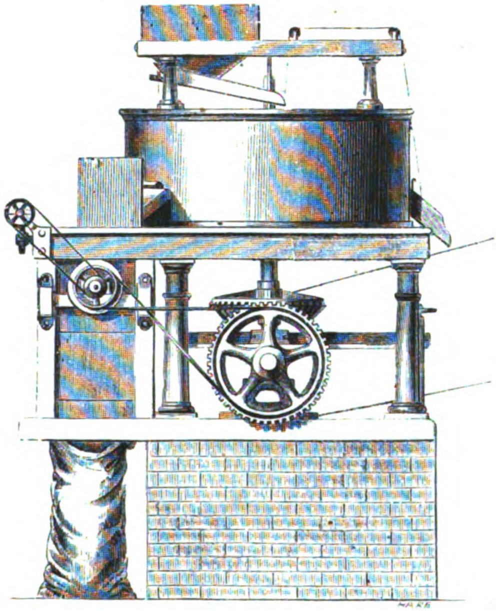
WITH FLOUR-DRESSING APPARATUS.

These Mills are in very general use for domestic purposes, and are simple and inexpensive. They are fitted with best French Burr Millstones, enclosed in iron casing, which may be easily removed when requisite for repairs. The Flour-Dressing Apparatus is constructed on the most simple plan consistent with thorough efficiency. They may be driven by hand or any other motive power.

Diameter of Stones.					
14 inches, for hand-power, with Flour-Dressing Apparatus			£11	11	0
16	ditto	ditto	13	13	0
18	ditto	ditto	16	16	0
20 inches, for steam-power, without Flour-Dressing Apparatus			20	0	0
22	ditto	ditto	23	15	0

Extra for Flour-Dressing Apparatus, from £10 to £25.

For larger sizes, see pages 321 to 324.



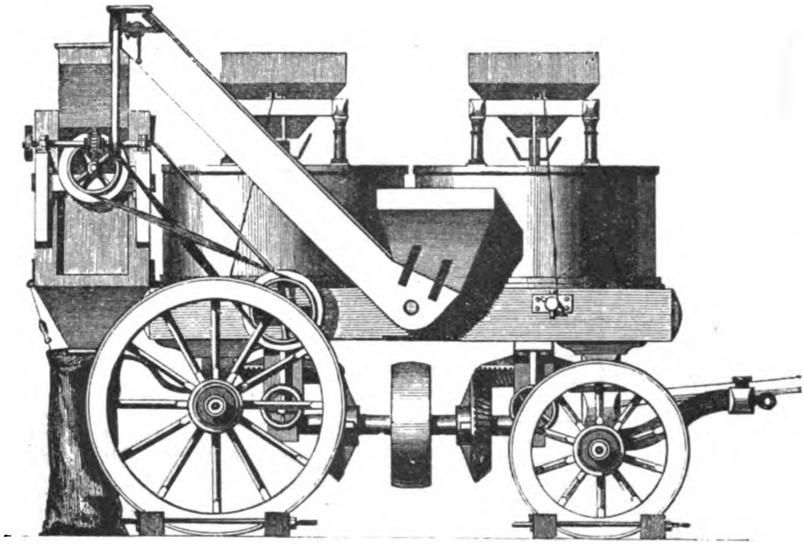
IMPROVED SINGLE CORN MILL, WITH FLOUR-DRESSING APPARATUS,

Is similar in principle to that described at page 322 but is more frequently used as a fixed Mill, although it can be easily moved from place to place, if desired. Where a large amount of work has to be done, two or more of these Mills may be put down side by side in any convenient building, each being worked by a strap from a line of shafting driven by a portable Steam-engine, or by water-power. Like the Portable Double Mill, this Mill is made with or without Dressing Machinery attached, and is so constructed that it will make the finest dressed flour, or crush barley, peas, &c. as required.

PRICES.

Diameter of Stones	26	32	36	42	48 inches.
Mill with Derbyshire Stones . . .	£26	£34	£37	£41	£48
Ditto, with French Bed and Derbyshire Runners	£29	£37	£42	£47	£55
Ditto, with French Burr Stones . .	£32	£41	£47	£54	£64
With Flour-Dressing Machine, extra.	—	—	£25	£25	£25
Approximate weight of Mills without Dressing Machine	—	—	30	36	46 cwt.
Ditto, with Dressing Machine . . .	—	—	33	43	52 ,,
Measurement when packed, without Dresser	—	—	82	120	138 cubic ft.
Ditto, with Dresser	—	—	132	175	190 ,,

Wrought-iron Crane to lift Stones for Dressing, £6.



IMPROVED PORTABLE CORN MILL,

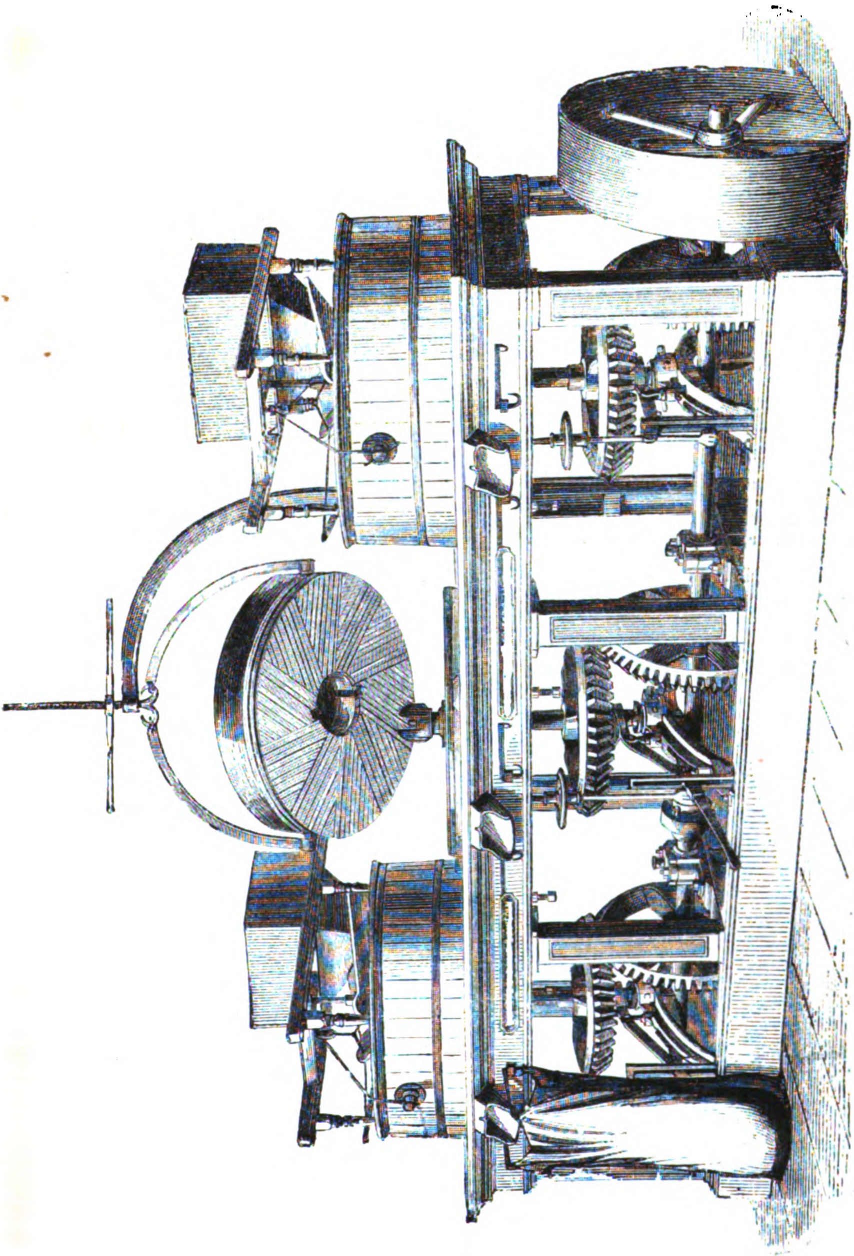
WITH TWO PAIRS OF STONES, AND APPARATUS FOR DRESSING FLOUR FOR HOUSEHOLD USE.

THIS Mill is specially adapted for use on large occupations, where steam or water power can be employed, as well as in the Colonies, or in thinly-populated districts, where "The Mill" is distant or difficult of access.

The stones are fixed upon a strong and well-seasoned timber platform. Vertical spindles, which are driven from below by the bevil wheels shown in the drawing, give motion to the top or runner-stones, and one of these wheels is geared with wood, so as to work noiselessly. The distance between the stones is regulated by a small hand-wheel, so that the Mill may be used for producing the finest flour, or for bruising or kibbling beans, peas, oats, &c. When required for the latter purpose, the Dressing Apparatus is detached, and the produce falls direct into the sacks. When used for producing fine flour, the meal falls into the hopper, and is thence carried to the Dressing Apparatus, where it is perfectly dressed and separated, fit for household use, and delivered into sacks.

When driven by an 8-horse power portable Steam-engine, or other equivalent power, this Mill will produce, with ease, 14 bushels (784 lbs.) of fine barley-meal, or 7 bushels (392 lbs.) of well-dressed flour per hour.

	PRICE.	WEIGHT.	MEASUREMENT WHEN PACKED.
	£	Cwt.	Feet.
Portable double Corn Mill, with French Burr Millstones, 3 ft. 6 in. diameter, mounted on Platform, and fitted with Carriage and strong Wood Wheels	130	80	290
The same as above, but with Flour Dressing Apparatus .	160	90	350



IMPROVED CORN GRINDING MILL ON IRON FRAME, WITH THREE PAIRS OF STONES.

IMPROVED CORN GRINDING MILL ON IRON FRAME.

WITH THREE PAIRS OF STONES.

		£	s.	d.
Three pairs of 4 ft. French Burr Stones	price	268	0	0
Three pairs ,, Derbyshire Grey Stones	,,	231	0	0
Two pairs ,, French and one pair of Derbyshire Stones	,,	256	0	0
Two pairs ,, Derbyshire and one pair of French	,,	243	0	0
Loose Pulley 4 ft. diameter extra	,,	3	5	0
Wrought-iron Crane to lift the stones, extra	,,	7	10	0
Governors, per set, extra	,,	13	0	0

IMPROVED MILL ON IRON FRAME FOR GRINDING COPROLITES.

Diameter of stones	4 ft.	4 ft. 6 in.	5 ft.
With two pairs of French Burr Stones	£215	£242	£274
With one pair of French Burr Stones	108	121	137

Prices of French Burr Grindstones for Grinding Coprolites, faced, and work put in—

Diameter	4 ft.	4 ft. 6 in.	5 ft.
Price, per pair	£36	£44 10s.	£55

Prices of Mill Stones—

Diameter	12	18	24	30	36	42	48	54	60 in.
Best French Burr, per pair	£2 3s.	£3 15s.	£6 10s.	£9 14s.	£13.	£17 5s.	£23 15s.	£30.	£36 10s.
Derbyshire Stones ,,	£1 2s.	£1 17/6	£2 14s.	£3 10s.	£4 17s.	£6 10s.	£8 12s.	£10 5s.	£12.

Intermediate sizes are made at corresponding prices.

RICE POLISHING MACHINES.

(For engraving and description see p. 327.)

No. 1.	Price	£40	0	0
No. 2.	,,	61	0	0
No. 3.	,,	78	0	0

Packing for shipment about 5 per cent. extra.

No. 2.—DECORTICATING MACHINE, OR PEARL BARLEY MILL.

(For engraving see p. 326.)

The machine is equally adapted for decorticating wheat or rice, or for pearling barley, and it has been successfully used for each of these purposes.

No. 1.	Stone 2 ft. 6 in. diameter by 9 in. wide	£40	0	0
No. 2.	Stone 2 ft. 9 in. diameter by 12 in. wide	61	0	0
No. 3.	Stone 3 ft. 3 in. diameter by 1 ft. 9 in. wide, the outer case covered with steel wire, and driven by wheel and pinion on *each* side of case instead of on one side only, as shown in the engraving	80	0	0

MACHINERY FOR THE PREPARATION OF RICE.

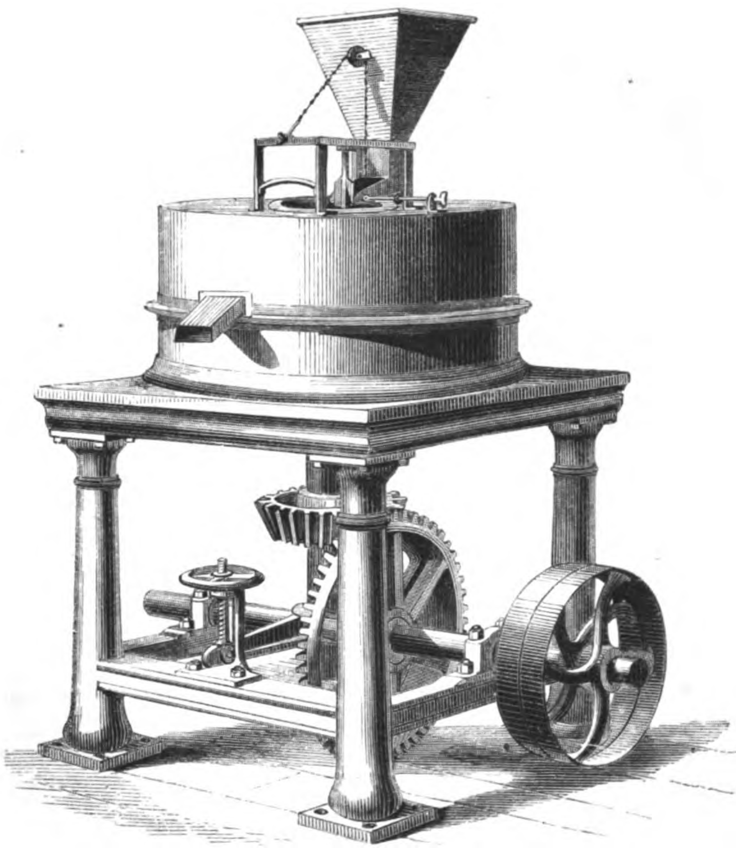
In the preparation of rice the first operation is that of separating the grain from the straw, in which state it is known as "paddy," and the second is, cleaning the grain ready for market.

The import duties on cleaned rice being six shillings per cwt. from foreign countries, and sixpence from British possessions, whilst that payable on "paddy" is only seven shillings *per quarter* from foreign countries and one penny from British possessions, it is usually imported to this country in the form of "paddy," but as cleaned rice is often required for use abroad as well as in this country, the subjoined information may be found useful.

Where sufficient capital is at command, and the quantity of work to be done is considerable, a thrashing machine (See pp. 314), may be employed for the first process, but it is more frequently done in the very ancient way of treading out by cattle.

It afterwards passes through a winnowing machine (See pp. 330), which separates the chaff and short straws, in which state it is usually shipped to this country.

For finishing rice fit for market, the machinery required will be briefly described; the mill best adapted for the purpose is a building of two or more floors. The "paddy" is delivered on the ground floor of the mill, and is carried to the top floor, where it is stored in quantities; this is done either by an ordinary sack tackle, or by an elevator or "Jacob's Ladder" as may be most convenient.



RICE HUSKING MILL.

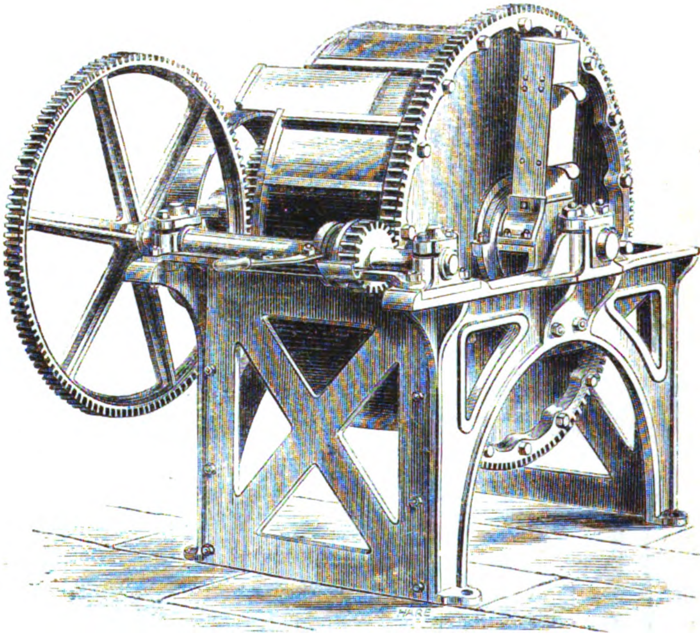
From the top floor the grain is conducted through hoppers in the floor to a screen which separates it into two sizes, and removes any stones or foreign matter which may have become mixed with it.

The two sizes of grain fall into two hoppers placed over two husking mills, each being set, by means of adjustable screws, to properly husk the size of grain in the hoppers above-named.

The engraving on page 325 shows an independent mill, but they are modified in construction to suit circumstances. In a well-constructed mill it is usually most convenient to drive the machinery from a line of shaft running below the floor, and for recutting or dressing the stones a light wrought-iron crane is used, which can be moved from one mill to another, for lifting the upper part of the machinery.

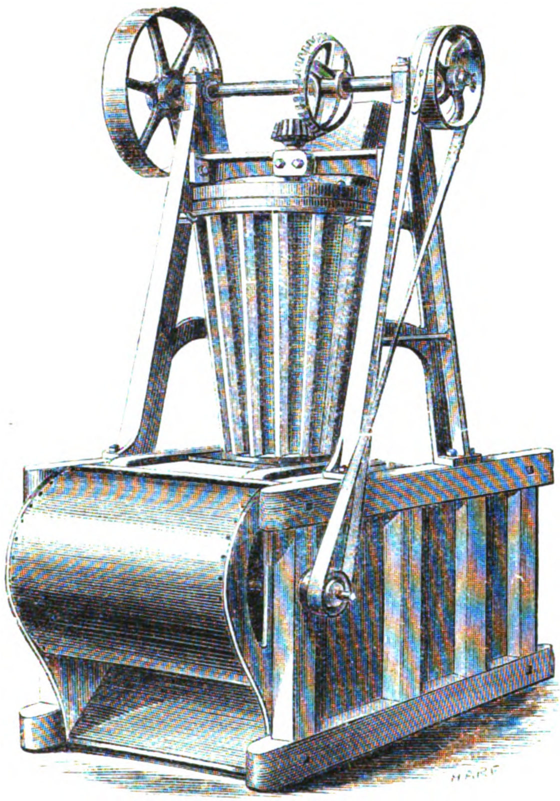
Externally these mills resemble an ordinary flour mill, but their lower or bed stone is *fixed* to the vertical spindle, and revolves, and the *upper part* is made the bed, which is adjustable by screws to the running stone, and is formed in this case of an iron plate, faced and lined with wood, the wood again being covered with cork or India-rubber. The grain enters through the centre or eye between the stone and the bed, and the friction rubs off the husk, and discharges it at the periphery into the case. The grain is now loose from, but mixed with, the husks, and an elevator again conveys it to another screen and blower on an upper floor, where the husks are removed.

The next process is to remove the inner cuticle or red skin, and having first been made for decorticating barley in the manufacture of pearl barley, the machine used for this purpose is generally termed a barley mill.



DECORTICATING MACHINE OR PEARLING MILL. (For Prices, see p. 324.)

The mill consists of one ordinary grindstone revolving on an horizontal axis, passing through the centre of the outer case, which rotates slowly in the *opposite direction* to the stone; the case is lined with wire gauze to permit the exit of dust; the grain is fed into the outer case through an eye, and fills the space between the gauze and the stone. The rapid motion of the stone and counter-motion of the case exposes the grain to great friction, which causes it to swell and thus to split the skin, which passes off in dust through the outer case. These mills can be made self-acting, to charge and discharge themselves from a hopper in any given period, but in some mills it is the practice to merely allow the grain to run slowly into the machine, a corresponding quantity being discharged, which passes into another mill and so on until sufficiently done: elevators or other mechanism conveying the grain from mill to mill.



RICE POLISHING MACHINE. (For Prices, see below.)

The next process is termed "polishing," and the machine for that purpose is a vertical hollow conical cylinder, in which rotates a cone on a vertical axis; the surfaces are covered with sheepskins, and a blower and screen are placed below the cylinder; the grain, after being fed from a hopper above the cylinder, passes between the skins; the one being fixed, and the other revolving. The grain is polished, and the fan removes the dust, the screen sizing and separating the broken grains, the percentage of which, in a properly constructed mill, is very small. The finished grain passes to the sacking apparatus or store bin ready for market. Prices are given for various machines employed in this process, and for large establishments special designs, arrangement, and estimate are required; but as a guide to cost, a plant doing 8 tons of finished rice per 24 hours consists of—

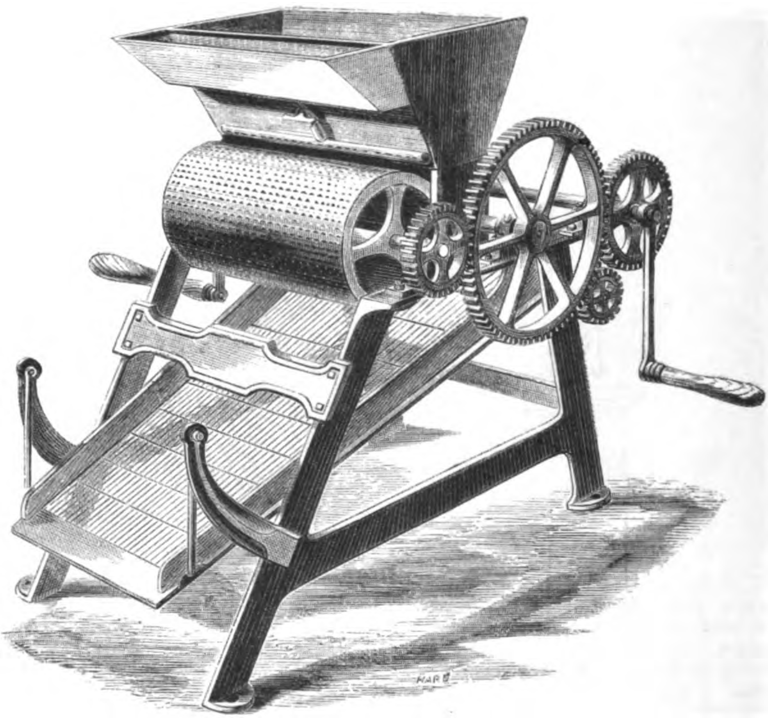
2 Husking Mills, 4 ft. diameter	£165
2 Barley Mills (or decorticators) 3 ft. diameter	154
2 Polishing Machines	156
Sack Tackles and Screens	50
Elevators, Shafting with brackets, bearings, &c. and Straps	150
One 12-horse power (nominal) Steam Engine and Boiler, with connections, &c.	300

The cost of the whole of this machinery is about £975, to which would have to be added the cost of transport and erection, and about 5 per cent. for the cost of packing, marking, &c.

As the grain works much better when dry than it does when moist, a drying floor is generally a useful addition. This can be heated either by the exhaust steam from the engine, or hot water conveyed through a range of pipes, or by hot air flues, as may be most convenient or economical. The hands required are one engineer, one miller, and two assistants, and the fuel used will be about 15 cwt. of coal for 10 hours' work.

COFFEE DRESSING MACHINES.

The first Machine employed is the Pulper, which removes the fleshy outer covering of the berries, and the Coffee beans are delivered from it enveloped in a parchment-like cuticle or covering, and they are usually allowed to remain to dry for some hours in the sun.



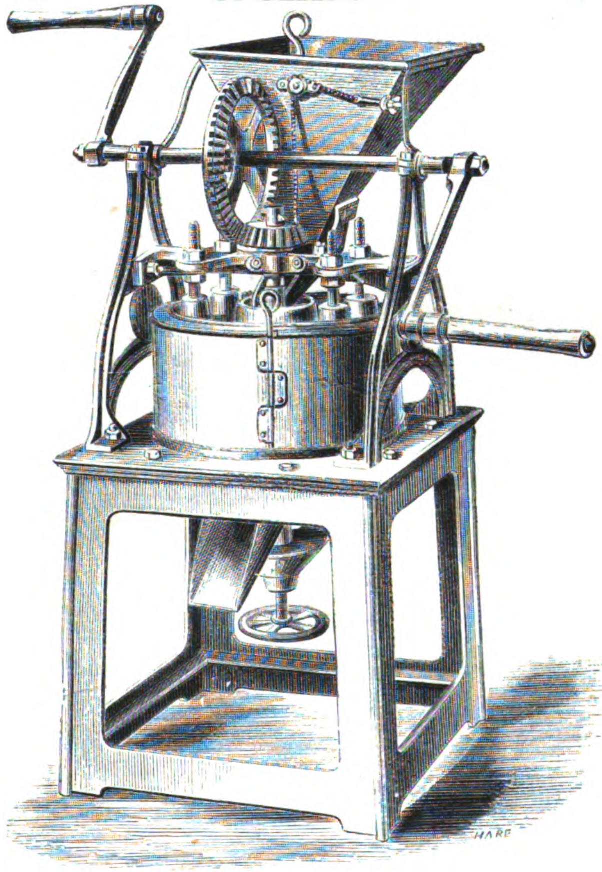
COFFEE PULPING MACHINE.

The Machine illustrated consists of an iron frame carrying an iron cylinder covered with copper, which is serrated, and revolves close to a breast-plate, but not in contact with it. The berries are placed in the Hopper or Trough above the roller, and this is kept filled with water, in which the berries float; but heavier substances, such as stones, &c. which would damage the roller, sink to the bottom: the berries float forward to the revolving cylinder, which rubs off the pulpy matter, and the beans are carried into a suitable receptacle below the screen, the pulpy matter being washed away beyond it. The water is also required for washing away the pulpy matter.

The Machine will pulp about 30 bushels per hour, and it is easily worked by two men.

Price of the Machine, with copper covered Cylinder, Hopper, Pipe, and Sieve, complete £33 0 0

Packing for Shipment, £2 0 0. Weight about 15 cwt.



"RETRILEA" OR HUSKING MACHINE.

When the beans are dry they pass through the Husking Machine, which frees them from the parchment-like cuticle above alluded to, and delivers them ready for cleaning and sizing.

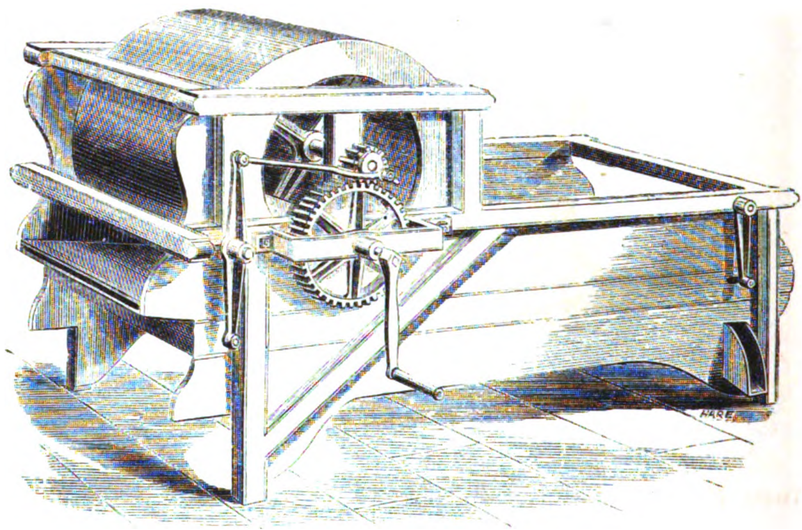
These Machines, driven by manual power, are made of various sizes, and the subjoined prices, including everything ready for work—

Diameter of stone.	16	18	20	22	24 in.
Price	£18 0 0	£19 0 0	£20 0 0	£21 0 0	£24 0 0

The 16 and 18-inch Machines are adapted to work by hand, and they will clean 3 to 4 bushels of Coffee per hour; the larger sizes should be driven by power, and the yield obtained is larger in proportion to the size.

For large establishments a Machine is made which will thrash or husk 10 to 12 cwt. per hour, and the price complete, with brushes, and fitted for power, is £130, and the weight about 5 tons.

The last process is that for blowing off the refuse, and separating the berries into three sizes, ready for bagging and sending to market.



COFFEE DRESSING AND SIZING MACHINE.

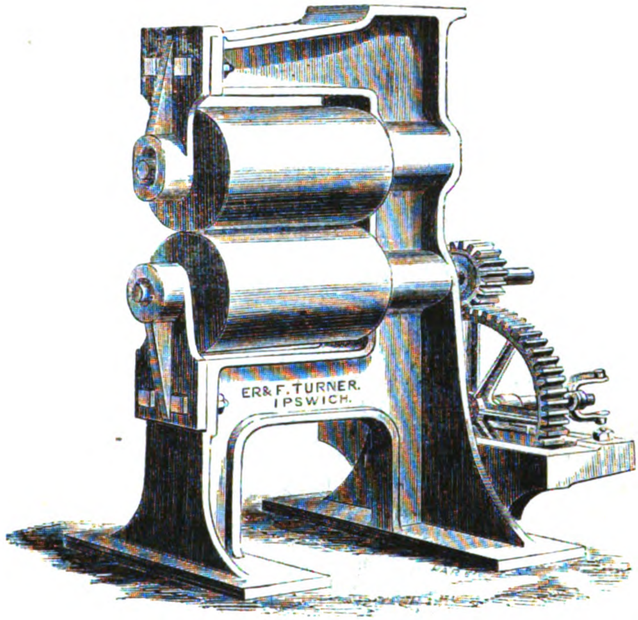
Price, with handle £15 10 0
Price, with fast and loose pulley, and set collar for power . . £16 15 0
Packing for Shipment £2 5 0
Measurement when packed about 150 cubic feet.

The cost of a Plant of Machinery, to clean and prepare for market about 10 cwt. of Coffee per hour, all the Machines of the best construction, and to work by power, and consisting of—

Two Pulpers, one Retrilea or Husker, and one Separating and Sizing Machine, is £250 0 0

Packing for Shipment 5 per cent. extra.

The power required is an Engine of about 4 horse power.

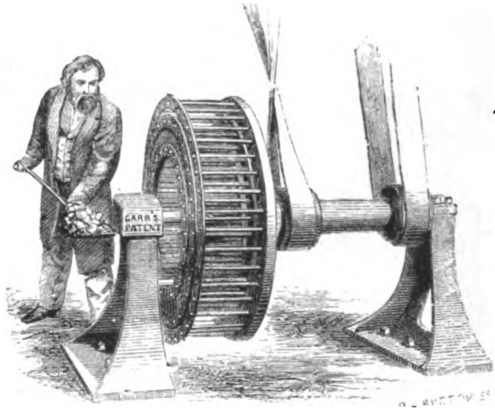


FLAX SEEDING ROLLS.

These Rolls have been extensively used for extracting the seed from the Flax straw, and as they ought to revolve at a considerable velocity, they are made to be driven by horse or steam power. The upper Roll is fitted with sliding bearings, and is made to revolve by contact with the lower one which is driven.

The Rolls being in motion, the seed ends of the flax straw are fed into the machine by hand, when the weight of the upper Roll breaks the seed boles and releases the seed.

	£	*s.*	*d.*
For Steam Power, with pulley, the Rolls 2 ft. long × 1 ft. diam. . . .	22	0	0
For Horse Power, with speed wheels and universal joints	25	0	0
Four-wheel travelling carriage and shafts for horses, extra	10	0	0



CARR'S PATENT DISINTEGRATOR.

The Disintegrator consists of four rings one within another, each ring being formed of a pair of flat wrought iron frames with round wrought iron bars between them, each alternate ring running in opposite directions. The stuff to be operated on is fed in the centre, and is discharged on the outside. The rings revolving in an opposite direction at a circumferential velocity of from 4,000 to 7,500 feet per minute, the stuff is beaten from bar to bar in its passage through the rings, and receives an almost incalculable number of blows; the most refractory materials are thus pulverised, and whatever moisture they may retain, even of a glutinous character, such as will be found in sugar scum, guano, or other conglomerated manures, wet or semi-dried clays, &c., is driven off, and the materials are delivered in an incredibly short time in a fine dry powder.

But the machine is equally applicable and is extensively used in pulverising fire clay, burnt bricks, glass, bones, coprolites, &c., as well as for mixing colours of different shades to bring them to an uniform sample.

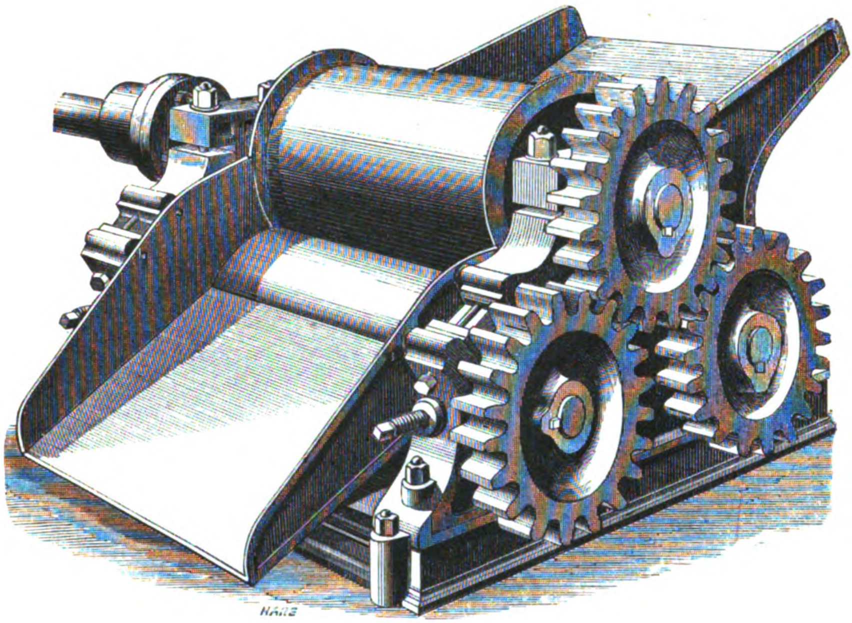
PRICES, EXCLUSIVE OF THE PATENTEE'S ROYALTY.

Size.	Price.	Weight.	Speed per minute	Approximate* Power required	External Casing, extra.
	£ s. d.				£ s. d.
3 ft. diam.	65 0 0	15 cwt.	450 revolutions.	6 H. P.	5 0 0
4 ft. „	75 0 0	27 „	400 „	10 „	6 0 0
6 ft. 3 in. „	150 0 0	57 „	350 „	20 „	included.

Patentee's Royalty for the use of one machine, £10 per annum. Or all further liability on account of royalty may be compounded by a payment of £20, if made six months before the current year's royalty becomes due.

No royalty is charged on machines used abroad.

* The power required to work the machines can only be given *approximately*, as it will vary according to the materials operated on and the amount of work done in a given time, and may, therefore, be more or less than that indicated in the table.



IMPROVED SUGAR-CANE CRUSHING MILLS.

THESE Mills are specially designed to supply a want much felt on large estates, where the distances are great between the "Mill" and the plantation; the object being to fix SEVERAL SMALL MILLS in convenient positions near to the sugar-canes, and to avoid the expense of removing the canes, &c. Many of these Mills are now in use, and are highly approved.

The Mill consists of a massive cast-iron bed-plate and framework for carrying the three iron rollers, which are each fitted on a wrought-iron shaft, with gun-metal bearings, and a strong pinion-wheel keyed on the end of each shaft to give motion to the whole; also feed-plate, trash-plate, spout, all necessary bolts, nuts, &c. &c. Size of Rollers 16 in. diam. by 20 in. long.

For Water or Steam-power (as shown). Price £100.

The above Mill, fitted with 6-Horse Power Horizontal Steam-Engine, Egg-end Steam Boiler, and all necessary fittings, connecting pipes, valves, cocks, intermediate gearing to reduce the speed of Mill 1 to 16 revolutions of engine, all shafts and bearings, ready for fixing, complete. Price £300.

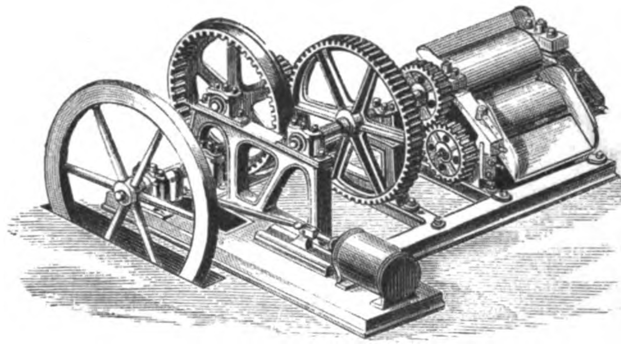
If fitted for horses or bullock power, with level wheels, upright shaft, footstep and top bearings, cast-iron cap to carry the levers, each lever fitted with draw-bows for horses or cattle, rollers 14 inches diameter by 20 inches long. Price £95.

A smaller size Mill is made. Price £75.

SUGAR MILLS of larger sizes made to order.

CANE-TOP CUTTERS, No. 1, £7—No. 2, £10—No. 3, £14.

SUGAR MOULDS, FUNNELS, and all articles for the Sugar Trade.



SUGAR CANE MILLS.

STEAM CANE MILLS.					WATER CANE MILLS.
No.	H. P. Nominal.	Size of Rollers.	Sugar made in 12 hours.	Prices.	Prices.
		in. in.	Tons.	£ s. d.	£ s. d.
I.	5	24 × 18	1	415 0 0	155 0 0
II.	7	28 × 20	1½	490 0 0	250 0 0
III.	9	32 × 22	2	620 0 0	312 0 0
IV.	12	36 × 24	3	810 0 0	450 0 0
V.	16	42 × 26	4	1040 0 0	565 0 0
VI.	22	48 × 28	5	Special Quotations.	
VII.	30	54 × 30	6		
VIII.	35	60 × 32	7		

The Steam Cane Mills, Nos 1, 2, 3, and 4 are Combined Mills with extra (multitubular) boiler power. Nos. 5, 6, 7, and 8 are arranged with Steam Engine and gearing on separate framing; specially adapted for crushing the largest amount of Juice out of the Cane with the smallest expenditure of Fuel.

The Water Cane Mills.—These Prices include Water-wheel Shaft of wrought-iron, Centres, Blocks, and Holding-down Bolts; also pair of Spur Wheels for connecting the water-wheel with the Mill.

Special Estimates given for Water Cane Mills suited to particular falls of water, applying the form of Water-wheel calculated to give the best results.

CATTLE CANE MILLS.

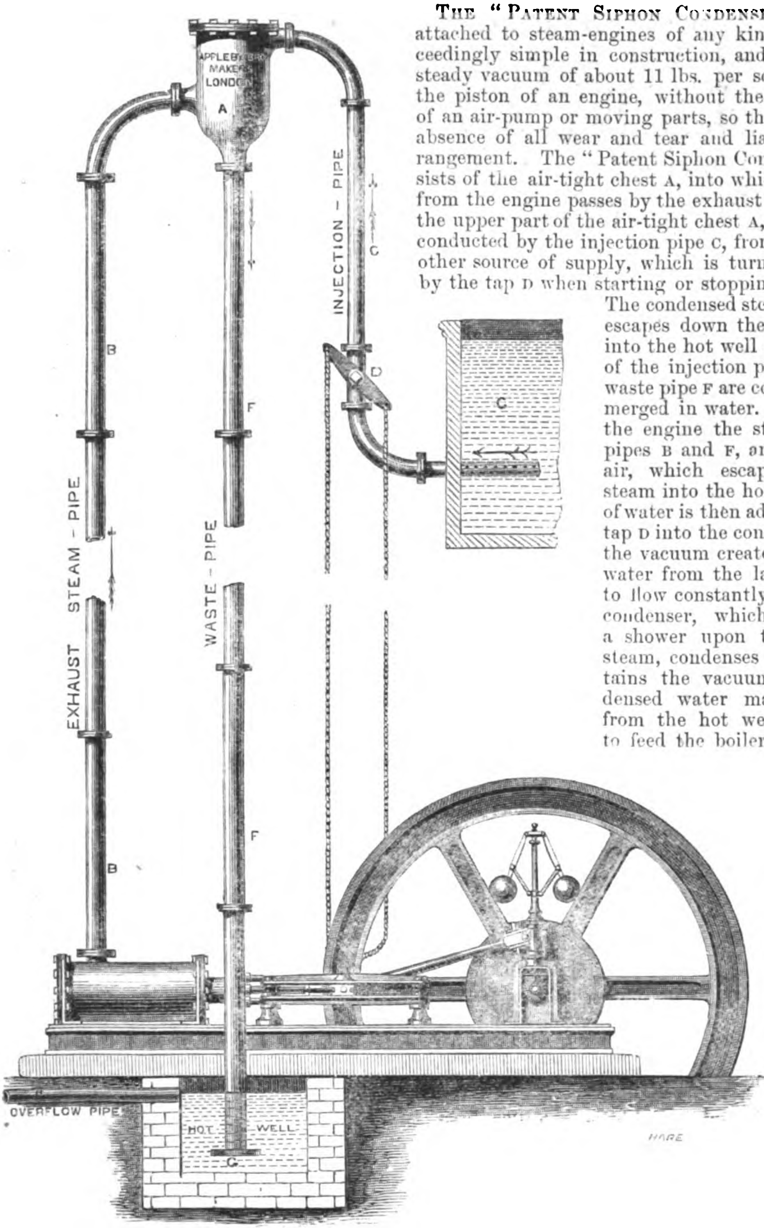
No.	Cattle required.	Size of Rollers.	Sugar made in 12 hours.	Prices.
		in. in	Tons.	£ s. d.
I.	2	17 × 13		92 10 0
II.	4	21 × 16		115 0 0
III.	6	24 × 18		138 0 0
IV.	8	28 × 20		185 0 0

All the above Mills are arranged from experience of the requirements of Sugar Estates; strength, speed, &c, having been especially studied. The requisite tools for erecting the machinery will be sent with the Mills, and are included in the prices quoted.

			£		£
Evaporating Pans in Sets for Open Fire (Cast-iron)		from	12	to	50
,, ,, (Wrought-iron)		,,	50	to	300
,, Steam ,,		,,	100	to	600
Vacuum Pans					
Centrifugals (30 inches to 48 inches					
Wetzels		,,	20	to	100

Rum Stills (from 250 gallons and upwards) of the most approved construction.

THE "PATENT SIPHON CONDENSER."



THE "PATENT SIPHON CONDENSER" may be attached to steam-engines of any kind. It is exceedingly simple in construction, and maintains a steady vacuum of about 11 lbs. per square inch on the piston of an engine, without the intervention of an air-pump or moving parts, so that there is an absence of all wear and tear and liability to derangement. The "Patent Siphon Condenser" consists of the air-tight chest A, into which the steam from the engine passes by the exhaust pipe B. Into the upper part of the air-tight chest A, cold water is conducted by the injection pipe C, from a cistern or other source of supply, which is turned on and off by the tap D when starting or stopping the engine. The condensed steam and water escapes down the waste pipe F into the hot well G. The ends of the injection pipe C and the waste pipe F are constantly submerged in water. On starting the engine the steam fills the pipes B and F, and expels the air, which escapes with the steam into the hot well. A jet of water is then admitted by the tap D into the condenser A, and the vacuum created causes the water from the large cistern C to flow constantly through the condenser, which falling in a shower upon the incoming steam, condenses it and maintains the vacuum. The condensed water may be taken from the hot well or cistern to feed the boilers, or for any other purpose. The overflow pipe H carries off such surplus water as may not be required. The quantity of cold water necessary is not more than for an ordinary condensing engine, and if it should have to be pumped into the cistern C the saving of power would then average about 10 lbs. pressure per square inch of piston area.

COAL TIPS.

APPARATUS for discharging a truck-load of coals into a ship's hold or a steamer's coal-bunkers must necessarily, to some extent, be designed to suit local conditions; but there is a general similarity in arrangements of machinery for this purpose, and those described below are capable of modification to suit a great variety of circumstances.

Where the rail level is at a sufficient height above the water level, the arrangement erected by the authors for the Dutch Rhenish Railway Company at Amsterdam may be advantageously employed.

The machinery is of the simplest character, and consists of a vertical steam-engine similar to that illustrated at p. 32, which has a capstan on one end of an intermediate shaft, the other end being used for working a double-acting pump to a pressure of about 500 lbs. per square inch and fitted with a large air-vessel. From this pump the water is conveyed to a hydraulic cylinder of about 9 ft. stroke, hung in trunion bearings which are fixed at a convenient depth below the rail level. The diameter of the ram is 12 in. and the head spherical, and a cup to receive it is attached to the under side of a tipping platform. The coal trucks are run into a siding parallel with the quay line, and are drawn forward to a turntable opposite to the tipping platform by a rope worked from the capstan end above named; the same rope also pulls them round to the desired position when on the turntable. The truck is then pushed on the tipping platform and the pump is set to work, which raises the platform and the truck to an angle of about 45°, and the coal is discharged into the vessel below. The empty truck is then drawn off and is replaced by a loaded one. The hands required are one man to drive the engine and attend to the pumps, and two men working the trucks at the tip, and the duty has been twenty 12-ton trucks discharged and shunted clear away in one hour.

Although the work done by the single tip is more than was at first deemed necessary, the traffic has increased so much that a second has been put down; this is precisely similar to the first, excepting that the engine is powerful enough to work the two tips, or even a third, which will probably be required.

The cost of the engine, boiler, pump, gear, and hydraulic cylinder and ram, is about £335.

In another arrangement, where the rail level was about 20 feet above the quay line, and where the variation of tide is considerable, the waggons are usually lowered by gravitation to as near the deck level as admits of the coals being tipped, to avoid unnecessary breakage, but with high tides, or vessels of heavy burden, the waggons have to be lifted about 6 feet above the rail level before they can be tipped.

The apparatus consists of a long hydraulic cylinder, in length equal to half the height of the tip, and it is fitted with a piston and piston-rod, the head of which works in suitable guides, and carries a counterbalance box and monkey block to multiply the height of lift.

When tipping below the rail level, the hydraulic apparatus merely answers the purpose of a break for lowering the load to any desired level, and after the coal is discharged, the empty trucks are brought back to their original position by counterbalance weights. The water is then on the upper side of the piston, and acts as a break for the ascending trucks: during these operations the water only passing from one side to the other of the piston.

When used for tipping above the rail level, the pressure for lifting the loaded truck and cradle is supplied from a small direct-acting steam-engine and hydraulic pump working up to 700 lbs. per square inch, and fixed on a small vertical boiler. All these motions are worked from one valve, which is fitted with an index-plate and lever.

This apparatus was made by the authors for the Porthcawl Harbour Company, from the design of R. P. Brereton, Esq. C. E. and the cost, exclusive of any timber structure and erecting, is about £700.

In other cases, where the rail level is unavoidably and considerably below the level where the coal has to be discharged, the trucks are run on to a cradle, and a steam or hydraulic crane is used for lifting the truck whilst on the cradle and swinging it over the ship's hold, the tipping action being given by a light supplementary chain which is worked independently of the lifting motion.

Full particulars of each arrangement can be obtained from the authors on application, and most of those above-named have been illustrated and described in the technical journals of the dates when the works have been executed.

COTTON GINS.

"In every one of the numerous processes which cotton undergoes in its conversion from the raw material to the manufactured article the greatest care is required, and the most delicate manipulation demanded, in order that the fibre may not be damaged. It is liable to deterioration, from causes which present themselves at every stage. Thus at the outset the operation of picking appears a very innocent affair, and withal so simple as to render injury here practically impossible. Yet it is really the case that if the pod or husk is not left on the plant but is picked off with the cotton, it soon becomes very brittle and breaks up, and the fragments mixing with the fibre do it much injury, as it is difficult to separate the two again. The first mechanical operation to which the cotton is subjected after it has been picked is that of "ginning," which consists in removing the cotton fibre from the seed. The chief point in this operation is to prevent damage to the fibre and to bring it out as long as possible, thereby enhancing its commercial value. Doubtless of old the process was to take the fibre off the seed by the thumb and finger, and, if properly done, by no better means can it be effected. But the process is, and of course has long been, far too slow and tedious, one pound being the average day's work of a man. So machinery interposes and keeps supply on a par with demand. From the ancient finger-and-thumb process to the present finished mechanical appliances is a long stride; the intermediate space, however, is filled up by gradations of improvements. In the dawn of mechanical application the cotton gin consisted of nothing more than a simple stick of hard wood carefully rounded, and a flat stone. The fibre was rolled on the stone, the seeds being driven out before the roller, the diameter of which was too small for it to mount on to the seeds. In course of time, this rude contrivance was superseded by a machine, which—although one of the simplest kind—from its construction, was really entitled to be so called. This was the Indian churka or roller gin, which has been in use for something like two thousand years. It consists of two rollers, each of so small a diameter, that a seed will not enter between them, the angle formed by their surfaces where the seeds touched them being considerably greater than the angle of friction. The fibre is laid hold of at the point of contact, and, as the rollers revolve, is drawn through between them, being pulled off the seed. The Hindoo bow is an instrument for cleaning the cotton after it has been ginned from any loose seeds and dirt. This instrument is made of bamboo, and is fastened by strings to a wall about five feet from the ground. A second bow of larger size, and strung with thick catgut, is attached by a cord to the centre of the first, below which it is hung about three feet. The operator, sitting down, lays hold of the bow with his left hand, and with an ebony club strikes the string of the bow so as to cause the foul cotton spread on the floor around him to be tossed violently into the air, and thus deprived of its impurities. The coarser, stronger stapled cotton of Upland (Georgia, America) was originally cleansed by the vibrating stroke of the bowstring. The cord being raised by the hand, and suddenly made to recoil upon the seed cotton, separated the dirt and loose seeds and opened up the wool, the cause of the separation being the great difference in the weight of the seed and fibre.

"The Indian churka is still used by the natives in India, and it is stated that by means of the common implement they gin upwards of 75 per cent. of the cotton produced in India. It takes, however, about 20 persons to produce 1 cwt. of clean cotton per day, or about 9¼lb. per hour, not quite half a pound each person per hour. The top roller of the churka is now commonly made of iron or steel ¾ in. diameter, and is sometimes finely fluted, the bottom roller being of hard wood and from 2 in. to 3 in. diameter. Like as in every other department of manufacture, so in cotton ginning, invention has been actively at work, creating and bringing forth abundantly machines of varied construction. The numerical strength of the designs for separating cotton fibre from the seed is something very great. Not so, however, that of those practically carried out, and now chiefly used, which consist of three varieties—the old Indian churka, the Macarthy Gin, and the Saw Gin. The Macarthy Gins are a widespread race, but the family likeness is tolerably well preserved throughout. This gin consists of a roller covered with sea-horse hide, which is a very expensive material, costing something like 25*s*. per square foot. Against the roller a steel doctor blade is kept continually pressed by springs, the seeds being knocked off by a vibrating beater. By means of the adhesiveness of the leather the fibres are seized and drawn under the steel plate until the seeds come in contact with its edge. The vibrating bar or knife then ascends, and passing the edge of the plate pushes off the seed and sets free the fibre, which travels over the roller and is delivered over a rod in front. Messrs. Platt and Richardson's 40-in. hand-feeder Macarthy Gin, single knife, for power, produces about 30 lbs. of clean cotton per hour, Smyrna or Indian: or 40 lbs. per hour of Egyptian or American. A 12-in. gin double knife and worked by hand, as improved by the same firm, will produce 8 lbs. of the

COTTON GINS—*continued.*

former and 12 lbs. of the latter cotton per hour. The Saw Gin was invented about 1790 by Mr. Eli Whitney, of the State of Georgia, at a time when the cry of the cotton producers was great for a method of cleaning cotton which would enable them to keep pace with the demand of the times. This gin consists of a number of circular saws mounted about an inch apart on a revolving cylinder. The teeth of the saws are very pointed so as to claw hold of the fibre in their passage through narrow slits in the table. Another cylinder faced with brushes, works in an opposite direction and clears the cotton from the teeth of the saws. The work done by one man with a Whitney eighty-saw machine driven by a two-horse engine is stated to be 5,000 lbs. of seed cotton per day of fourteen hours. This would be about 1,250 lbs. of clean cotton per day, or about 90 lbs. per hour.

"The foregoing gins, however, are open to several objections. In the best machines of the churka class, the yield per day is very small, and as the rollers cannot be fed with perfect regularity they take hold of the cotton wherever it happens to lay thickest. In consequence of this imperfect holding, and owing also to the distance from the seed at which the fibre is held, considerable breakage occurs. By this means the average length of the staple is shortened. A further drawback, too, arises from the circumstance that soft or unripe and imperfect seeds are frequently carried through with the fibre. In the Macarthy Gin the fibre is only drawn in under the doctor-blade by the superior friction of the leather roller over the friction of the blade, consequently the fibre is but imperfectly taken hold of, and the beater drags out some of the fibre in beating off the seeds; hence the cotton is delivered in a broken and injured condition, the natural consequence of the severe rubbing it has undergone between the blade and the roller. The fibre by being shortened of course loses somewhat of its value in the market. The Saw Gin has a fault at the outset; it leaves a portion of the cotton on the seed, and, beyond this, it likewise breaks the fibre which it does take off to a very considerable extent. This is the case even with cotton of such a tough nature as New Orleans, whilst it is altogether unsuited for ginning tender or long fibre cotton on account of the quantity it destroys. Notwithstanding this, the Saw Gin is extensively used in America for short stapled tough fibre. This is principally owing to its ability to get through a large amount of work, although that work is done in a very inferior manner. It was set to work on some Indian and Japanese cotton, but, as it chopped up the fibre in a most merciless manner, the attempt so far may be considered a failure. It may be, however, that cotton grown and ripened at a high temperature acquires brittleness of fibre, the more so if the soil has not been kept well moistened. Although a great number of inventions have appeared in the States, which were meant to improve upon or to supersede the original Whitney Gin, it is a fact that the cotton gins in general use there, are facsimiles of it." *

The increase in the cultivation of cotton in various parts of the world other than those from which we formerly drew our supplies, has led to a very large demand for gins, and the unsatisfactory results obtained from some (the quality of the cotton having been depreciated in ginning to the extent of 2*d.* to 3*d.* per lb.) gave rise to a close investigation of the appliances used, and the result has been that numerous modifications, which were suggested in a long series of careful experiments, were carried out and several improvements have been made.

The gins now most extensively made in England are—

The Cowper Lock Jaw Gin.
The Knife Roller Gin.
The Macarthy Gin.
The Saw Gin.

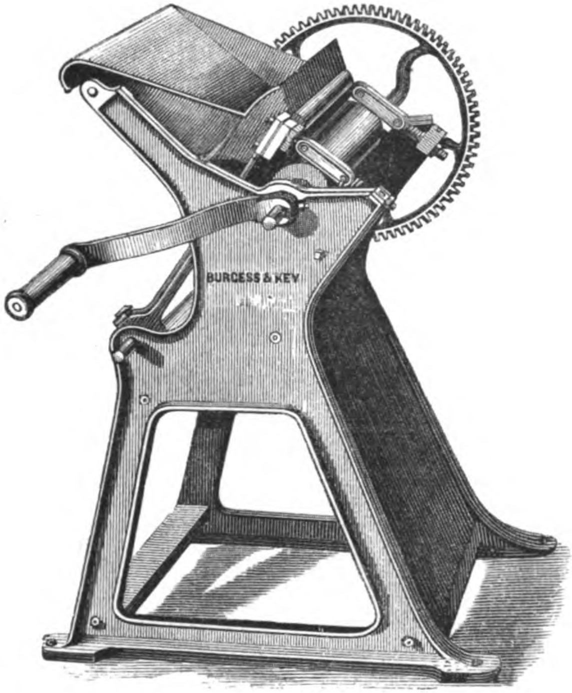
Taking them in the order in which they are named, the Lock Jaw Gin, the invention of Mr. E. A. Cowper, is an ingenious and scientific mechanical application of the action of the finger and thumb on the cotton, it therefore nips the fibre as it were with one hand close up to the seed, and the beater acts as the thumb of the other hand would do in detaching the seed, without injury to the staple, the object of the invention being to leave the fibre its full natural length, and uninjured by rubbing or rolling.

The Knife Roller Gin and the Macarthy Gin are so well known, that any remarks beyond those in the accompanying description are perhaps unnecessary.

As above stated, the Saw Gin does a very large amount of work at a small cost, but its action is such that the fibre must be injured to some extent; this may, however, be greatly reduced if samples of the seed to be ginned are sent, so that the machines may be constructed to suit the work to be done.

* Mechanics' Magazine, 6th October, 1865.

THE LOCK JAW COTTON GIN.



The jaw which locks fast the cotton fibre is formed by the nipping blade, which is caused to approach and nip the fibre on the roller, at the time it is travelling at the same surface speed, and in the same direction (so that there is no slipping or rubbing of the fibre on any surface), it being held perfectly fast between these two moving surfaces; and while it is so held, the beater acts on and pushes away the seeds close to the nipping blades, and separates them from the fibre close to the seed. The nipping blade then returns to its former position, moving in the opposite direction to the surface of the roller, and draws in a fresh supply of cotton for the nipping blade to take hold of it when it approaches the roller, and the nip is repeated. The nipping blade only slightly touches the roller, except at the moment when it is travelling with it, and at the same speed. Thus there is no rubbing of the leather as in a Macarthy Gin.

The surface of the metal roller is covered with bull neck or soft common leather (secured to strips of wood), which can be easily obtained for repairs, thus avoiding the great expense of entirely re-covering the roller with sea-horse hide.

The quantity of the cotton delivered varies according to the quality. The following is the production of cotton which has been cleaned on these gins, the roller being turned at 50 revolutions per minute, viz.:—

On a 14 in. Hand Gin.		On a 30 in. Power Gin.	
Egyptian	35 lbs. per hour.	Egyptian	76 lbs. per hour.
Pernambuco . . .	30 lbs. ,,	Pernambuco . . .	60 lbs. ,,
East India	21¾ lbs. ,,	East India	48¾ lbs. ,,

The gin is economical, it takes but little power to turn, is perfectly easy to manage, and well adapted for all qualities of cotton, from the longest-stapled Sea-Island to the shortest native Indian; and the cotton is left its full natural length, and free from injury by rubbing or rolling.

14 in. Gin, price £10. 30 in. Gin, price £20.

If fitted for driving by power 14/0 extra.

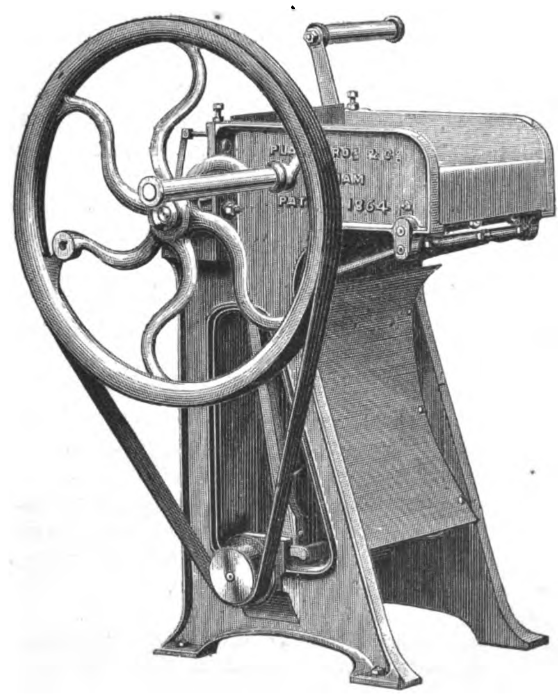
Packing and carriage to London, 12½ per cent. extra.

Ditto to Liverpool, 10 per cent. extra.

THE KNIFE-ROLLER GIN.

This gin has the usual "Macarthy" ginning roller (illustrated and described further on) with the steel blade or pressing knife pressed against its surface by springs and screws, but a knife-roller is substituted for the beater-plate used in the ordinary Macarthy Gin. It consists of a spindle carrying oval plates of about 5 inches diameter. These plates are placed diagonally with the axis on which they are fixed, and being oval, when caused to revolve, the blades or knives draw the cotton seed alternately right and left along the edge of the pressing knife, whilst the ginning roller pulls away the fibre from the seed, and it falls through a grating. There is a guard which prevents the seed being broken between the ginning roller and the edges of the knives on the knife roller.

No. and Sizes of Gins.	Production of Cleaned Cotton per hour.	Gross Weight when packed.	Prices. £	s.	d.
No. 1.—40 in. wide.	50 to 150 lbs.	6½ cwt.	15	0	0
„ 2.—30 in. „	36 „ 112 lbs.	6 „	12	10	0
„ 3.—20 in. „	25 „ 75 lbs.	4¾ „	10	0	0
„ 4.—12 in. „	12 „ 36 lbs.	4¼ „	7	10	0
„ 5.—8 in. „	8 „ 24 lbs.	2 „	6	0	0



PATENT DOUBLE-ACTING MACARTHY GIN,

TO WORK BY HAND AND WITH HAND FEEDER.

This machine will gin any kind of cotton without injury to the staple; two persons will attend to it, and produce (according to quality) from 8 to 12 lbs. of cleaned cotton per hour.

Machine 12 in. wide . £6 10 0
Ditto, with self-acting feed 8 0 0

Speed of handle-shaft, 40 revolutions per minute.

Space occupied, 3 ft. 9 in. × 2 ft. 9 in.

Weight, 4½ cwt.

Measurement, 19 cubic feet.

Packing and delivery in Liverpool, 15 per cent. extra.
Ditto, ditto, in London, 20 per cent. extra.

IMPROVED SINGLE-ACTION MACARTHY GIN, 40 INCHES WIDE.

LIKE that last described, this machine can be used for every description of cotton, and will produce from 25 lbs. to 50 lbs. of cleaned cotton per hour; the better the quality operated upon, the larger being the yield.

If fitted with the patent self-acting feed, one man will attend to three gins.

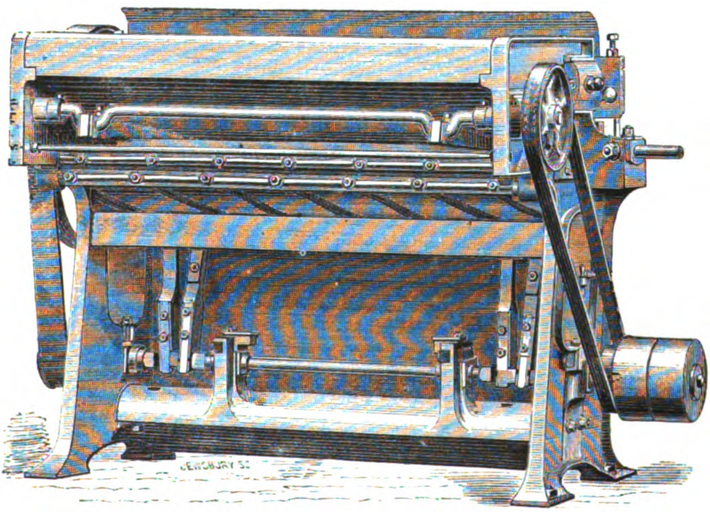
Machine 40 inches wide	Price	£11	0	0
Ditto, with self-acting feed	„	13	10	0

Leather Strap 4/9. Set of Screw Keys and Screw-driver, 6/0 extra.

Weight 7 cwt. Measurement 30 cubic feet.

Packing and delivery in Liverpool, 10 per cent extra.
Do. do. London 12½ „

The driving pulley is 6½ in. diameter, and should make 650 to 700 revolutions per minute; the floor space occupied by each machine is 4 ft. 11 in. × 2 ft. 10 in.



PATENT SELF-FEEDING DOUBLE-ACTION MACARTHY GIN.

THE double-action arrangement consists of a double set of knives set so as to balance each other, and each revolution of the crank giving two strokes of the knife, a large amount of work is done at a slow speed of crank shaft, whilst an easy and steady motion is maintained.

With the hand-feed apparatus this gin will clean—

30 to 35 lbs. per hour of Surat, Smyrna, or other short staples.
40 to 50 lbs. „ of Egyptian or New Orleans.
80 lbs. „ of Sea Island or other long staples.

If fitted with the patent self-feeding apparatus, the yield is increased 20 per cent. and one man will attend to six machines; with the hand-feed one attendant is required to each machine: there is, therefore, an important saving of labour in favour of the mechanical feed.

Machine 40 in. wide, with self-feeding apparatus	£16	16	0
Do. do. hand-feeding do.	14	0	0

Weight 9 cwt. Measurement 40 feet.

Packing and delivery in Liverpool, 10 per cent. extra.
Do. do. London, 12½ „

The driving pulley is 7 in. diameter, and should make 450 revolutions per minute; two indicated horse power will drive three machines, and each machine occupies a floor space 4 ft. 11 in. × 3 ft. 4 in.

PATENT DOUBLE-FORK KNIFE COTTON GIN, WITH SELF-FEEDER.

The arrangement of these machines is such that the knives cannot come in contact with each other, and whilst they possess all the advantages of the best type of Macarthy Gins, they are in some respects superior to them. They will clean any kind of cotton, and, being perfectly self feeding, when the machine is supplied with the usual charge of a basketful of cotton, no further attention is required until another supply is needed; one attendant can therefore easily serve two machines, and this gin has the advantage in economy of labour.

It is fitted with fast and loose pulleys 9½ in. diameter × 4 in. making 400 revolutions per minute, and the produce is from 100 to 300 lbs. of cleaned cotton per hour, as much as 250 lbs. of Brazilian (Kidney) seed cotton having been cleaned in the hour.

Each roller is 40 in. long, and consists of an iron body covered with leather, this construction being found to stand in any climate.

The floor space occupied is 10 ft. 4 in. × 3 ft. 4½ in. and about 3 indicated horse-power is required to drive each gin.

Price, including Royalty	£35	0	0
One set of leather driving straps	1	4	0
One set of screw keys and screw-driver	0	8	0

Packing for shipment and delivery in Liverpool or Hull, 15 per cent. extra.
Do. do. do. London, 20 do.

SAW GINS.

Gins with 18 Saws	Price	£18	0	0
Do. 22 do.	„	21	0	0
Do. 36 do.	„	30	0	0
Do. 50 do.	„	43	0	0

Packing and delivery in Liverpool, 5 per cent extra.
Do. do. in London, 10 „

THE PRICES OF PULLIES, SHAFTING, PEDESTALS, &c.

Engine, Horse, Bullock or other motive powers, as well as Hydraulic and Screw Presses for packing cotton, will be found in the various sections, and an approximate estimate will easily be made of the cost of a ginning establishment of any size, but when time permits it will be better to obtain proper plans, specification, and estimate for the work required. In such cases, the quantity of cotton to be prepared for market in a given time should be distinctly stated; and, if packing presses are required, the most convenient weight and dimensions for the bale to be made.

If an existing building is available for the purpose, a plan and elevation with figured dimensions should be given; but if a building has to be provided, it can be sent out complete, with each piece marked for erection on arrival at its destination, together with directions for fixing and starting the machinery. It is most desirable that all the conditions of working should be given as explicitly as possible, especially as regards the cost of labour and the kind of power most convenient in the locality; if engine power is required, the fuel which would be employed, and if animal-power is to be used, as nearly as possible the value of such power in comparison with the usual standard of horse-power used in this country. (See Tables.)

THE LOCOMOTIVE COTTON PRESS.

During several years' residence in the cotton-growing districts of India, where he was engaged in railway construction and superintendence, Mr. C. G. Wilson, the inventor of the Locomotive Cotton Press, had ample opportunity for observing the enormous loss to the grower and consumer arising from the practise of sending loosely-packed cotton long distances to the port where it is pressed up into bales for shipment, and these considerations led him to design the ingenious arrangement of machinery which is illustrated on the next page.

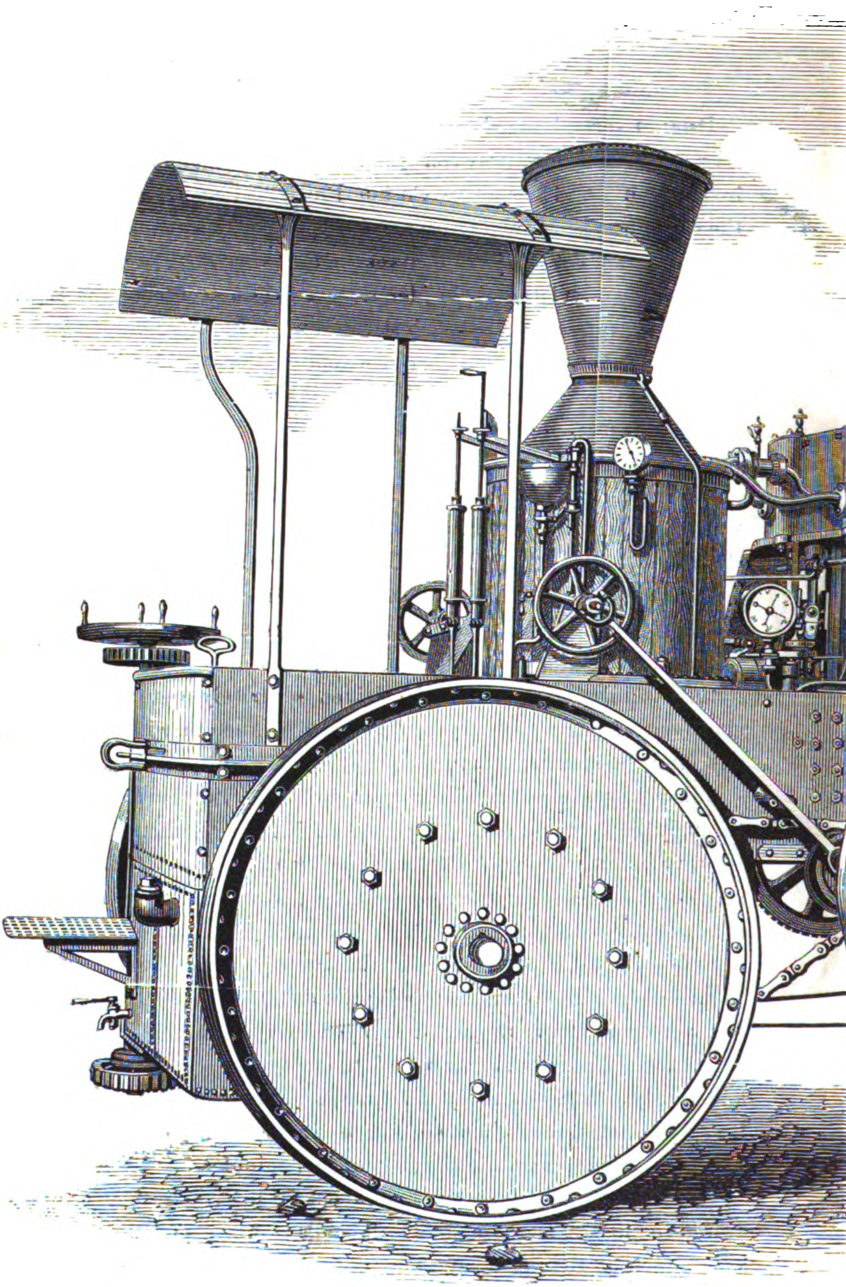
The Locomotive Cotton Press is a combination of the traction engine, the screw and the hydraulic press, the object being to obtain great portability as well as power and speed for pressing; the press-box is horizontal instead of vertical, as shown in the fixed presses illustrated and described further on.

The press and steam power for working it are fixed on one frame carried on wrought-iron travelling wheels, two being driving and two steering wheels, and steam is supplied from a powerful vertical boiler to a pair of steam cylinders, fixed on a strong vertical frame, and the motions for travelling along the road, driving the screws, and working the hydraulic pumps, are taken from the crank shaft.

The travelling motion is transmitted to the driving wheels by means of pitch chains, and these wheels can be driven separately or together, so that in turning sharp curves one wheel may be driven whilst the other is free to revolve or stand still, and the steering arrangement is worked from the foot-plate.

When pressing cotton, the top box is filled with the required weight of cotton through the doors on each side; the top follower is then allowed to descend, and the two screws are caused to advance by means of suitable gear. At the same moment the hydraulic pumps are started; the result being that the hydraulic ram is advancing with a slow motion to put on the final and extreme pressure simultaneously with the rapid advance of the screw pressure. When the cotton is pressed to one-seventh of its original bulk, the doors at top and bottom of the horizontal box are opened, and the bale is hooped and rivetted in the usual manner; this being done, the hydraulic ram and screws are run back to their original position, and the bale falls out ready for transit. The time occupied in pressing a bale is 2 to 2½ minutes, and when working in London with men quite unaccustomed to the work, a bale was made throughout in 7 minutes.

The screws exert a pressure of about 50 tons, and they compress the cotton 4 feet in 30 seconds; the hydraulic ram exerts a pressure of about 2 tons per square inch on the area of the ram, or = a total of about 100 tons, and it travels 1 ft. 1½ in. in 2½ minutes, the result being, that when the screws have made their



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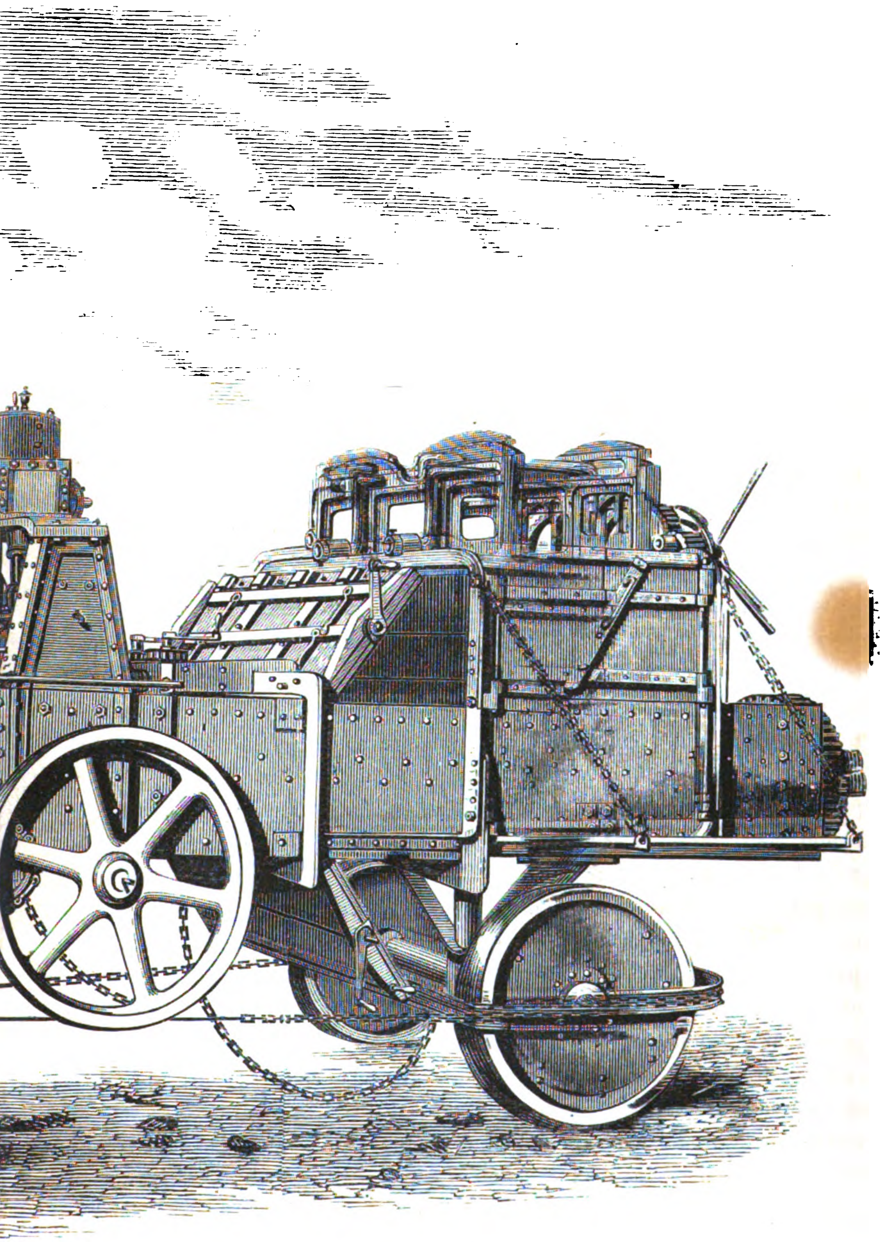


E COTTON PRESS.

whole stroke of 4 feet, the ram has to compress the bale 10·8 in. under the heaviest pressure, and the cotton is pressed to about one-seventh of its original bulk.

Arrangements are also made for driving other presses from pulleys on the crank shaft, and the engines are proportioned not only to work the additional presses, but to draw them along the roads.

The whole arrangement of the machinery is effective and simple, and it can be worked by one driver, the only assistance required being that furnished by the local native labour.

The machinery was constructed by the authors from the general designs furnished by the patentee, and was very severely tested in work before leaving this country. It will shortly be put to work in India, and will, probably, be a means of inaugurating a new system, profitable alike to the cotton producers in the East and to the consumers in Europe.

These machines can be conveyed on a railway truck to the stations nearest to where the cotton is produced, and will press the cotton into bales ready for shipment, or it may even travel by its own steam power to the depôts in the cotton fields.

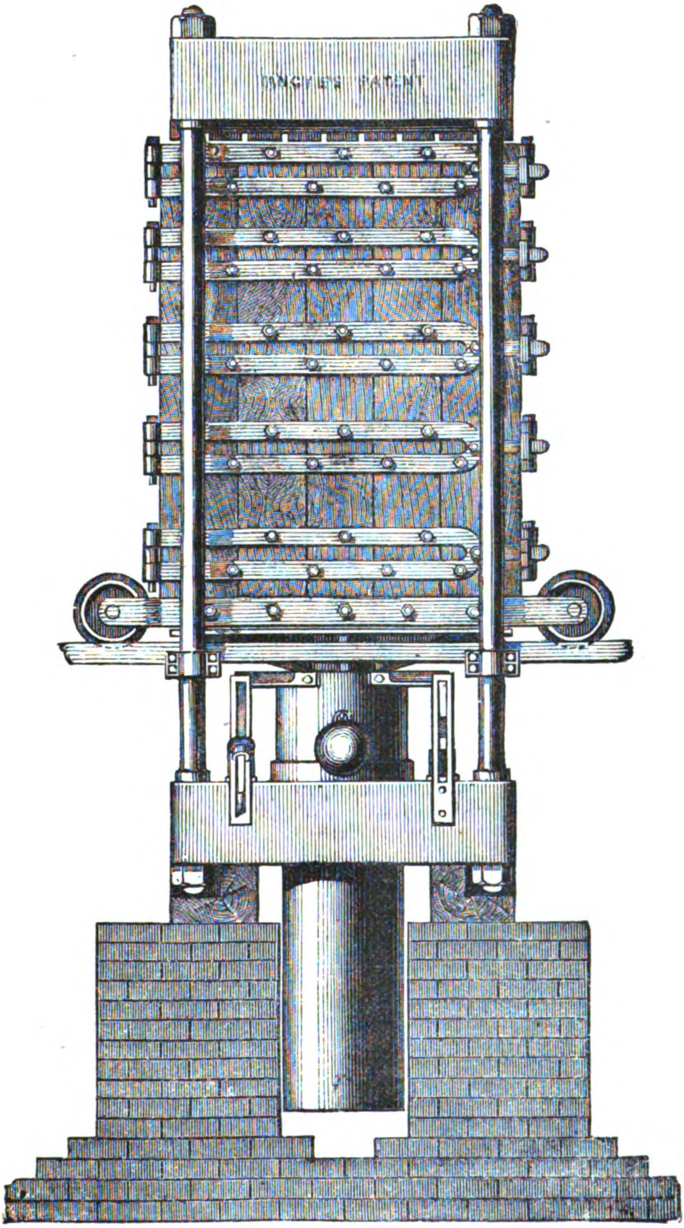
There appears little doubt that the Locomotive Cotton Press may become to the cotton grower what the thrashing machine is to our farmers, for it will enable him to send his cotton to market free from dirt and adulteration, being pressed under his own supervision, and direct from the gin. At the same time the bulk is reduced to such an extent, that a truck will hold seven times the weight that it would under the system usually adopted, which Captain Sherard Osborne calculates is equivalent to a saving *in freight alone of at least one farthing per pound on the average*, and the risk from fire is reduced to a minimum, it being well known that compressed cotton will not burn.[1]

This machine has been illustrated and described in most of the professional journals, and its success is anticipated with considerable certainty. Although designed primarily as a cotton press, it is evidently adapted for pressing other produce, such as wool, hay, esparto grass, &c. &c.

These presses are also made without the engine attached, and arranged to be driven by a strap from an ordinary fixed or portable steam-engine or other prime mover, and a traction-engine will transport and work three presses.

Any information desired may be obtained from the Patentee, or from the sole makers, APPLEBY BROTHERS, London.

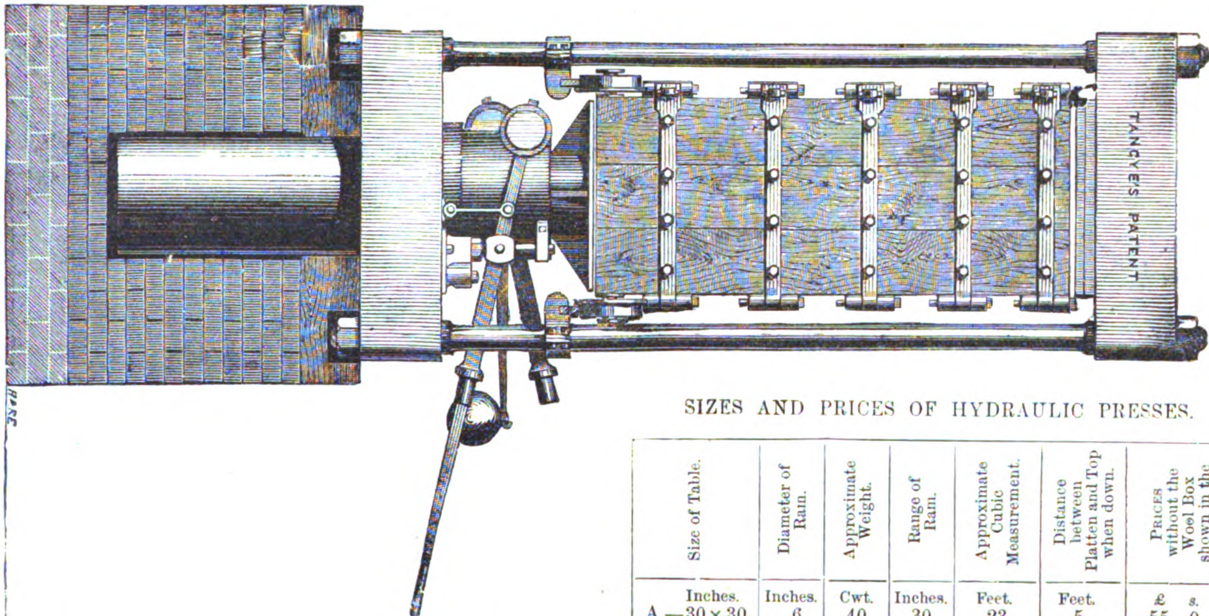
[1] One Indian railway company had claims amounting to £30,000 for cotton destroyed or damaged by fire in one single year.



HYDRAULIC COTTON PRESS, FRONT VIEW.

HYDRAULIC PRESS, WITH BOARDS, TANGYE'S PATENT.

THESE Presses are compact and simple in construction, and being fitted with moveable pressing boxes mounted on wheels, every facility is given for rapid working. The pumps and tank are in the bottom plate, by which the first cost is reduced, and a saving in space, in cost of freight and risk of breakage, &c., is effected.



HYDRAULIC COTTON PRESS, SIDE VIEW.

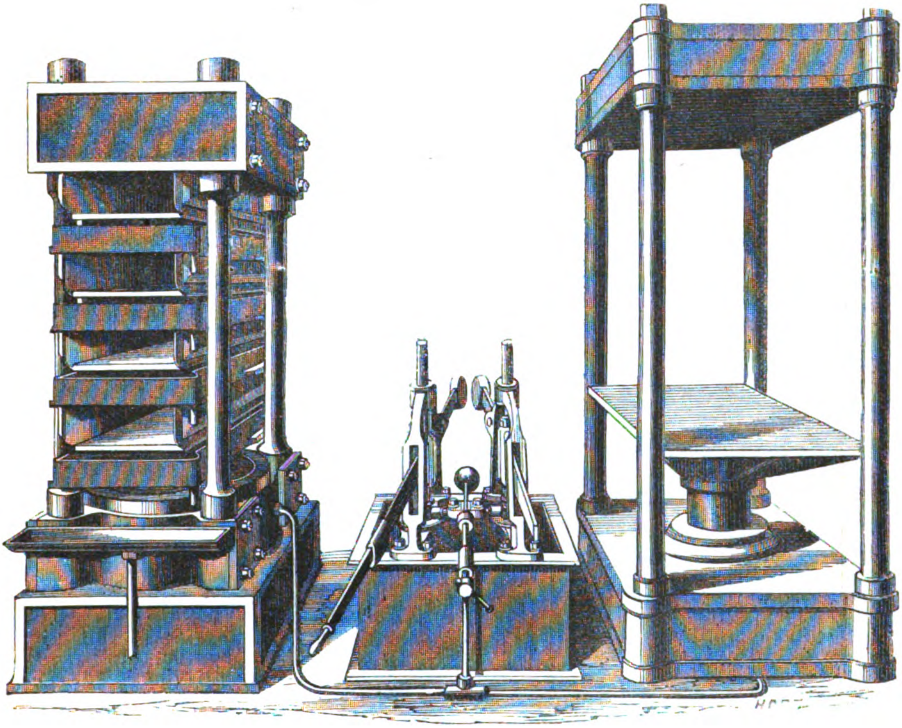
SIZES AND PRICES OF HYDRAULIC PRESSES.

Size of Table.	Diameter of Ram.	Approximate Weight.	Range of Ram.	Approximate Cubic Measurement.	Distance between Platten and Top when down.	Prices without the Wool Box shown in the Engraving.
Inches.	Inches.	Cwt.	Inches.	Feet.	Feet.	£ s. d.
A—30 × 30	6	40	30	23	5	55 0 0
B—46 × 36	6	45	42	25	7	65 0 0
C—30 × 30	7	45	36	28	6	65 0 0
D—46 × 30	10	60	36	40	6	82 10 0
E—48 × 42	10	100	36	48	6	102 10 0
F—48 × 42	10	110	42	50	7	105 0 0
G—84 × 42	10	120	42	90	7	135 0 0
H—96 × 48	10	140	54	122	9	170 0 0
I—34 × 34	7	60	30	40	5	70 0 0
K—66 × 30	6	90	48	—	6	80 0 0
L—66 × 30	7	130	48	—	6	120 0 0

Safety and Stop Valve, £2 10*s.* extra. If fitted with Double Pumps, £10 extra.

Wool Boxes and Hinges, if fitted as shown in the Engraving, are extra, ranging from £10 to £20; or if with Sliding Bars, as in the Screw Press, £5 each.

COST OF PACKAGE, FOR EITHER KIND OF PRESS, AVERAGES ABOUT 3 PER CENT ON THE ABOVE PRICES.



OIL PRESS (see p. 352.) DOUBLE PUMPS. PRESS FOR GENERAL PURPOSES.

HYDRAULIC PRESSES, WITH DOUBLE PUMPS COMPLETE,
FOR COTTON, WOOL, HAY, OR GENERAL PACKING PURPOSES.

Diameter of Ram.	Lift.	Price with Double Gun-metal Pump.
5 in.	5 ft. 6 in.	£115
6 in.	5 ft. 6 in.	£125

Safety-valve and Stop-cock, £5 extra.

If fitted with Boxes for packing Cotton, Wool, &c. extra from £5 to £12.

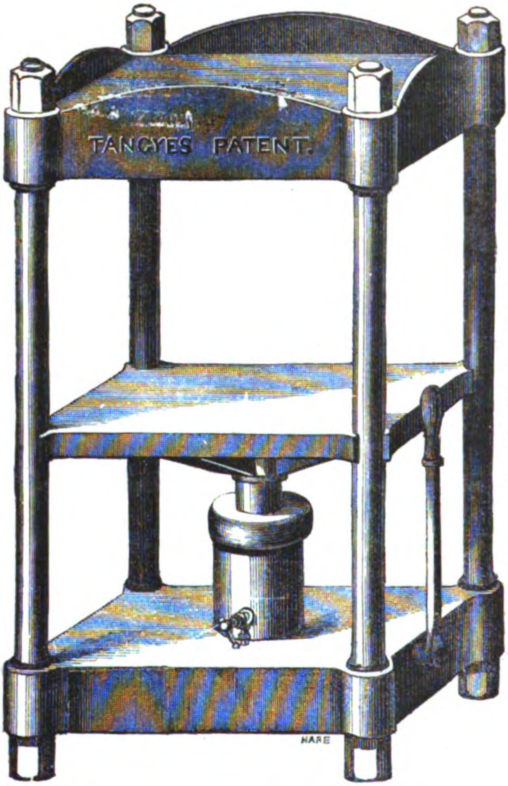
HYDRAULIC PRESSES made, *any size* or for *any purpose*, to order.

IMPROVED DOUBLE-ACTION HAY-PRESS.
TO PRESS THREE INTO ONE.

WHILST one bale of hay is being pressed ready for packing, the other end of the Press is open to receive another truss; the handle is reversed, the hay pushed along to the other end, and a considerable saving of time is thus effected.

This may be worked by any motive power, as STEAM, HORSES, HYDRAULIC, &c., and is applicable for pressing Wool or Cotton in the Colonies or elsewhere.

WILSON'S PATENT LOCOMOTIVE COTTON PRESS, see pp. 343 to 346.



THIS HYDRAULIC PRESS is cheap, simple, and not liable to get out of order, and it is extensively used by Printers, Bookbinders, Packers, &c., as well as for pressing Wool, Cotton, Hay, and other products.

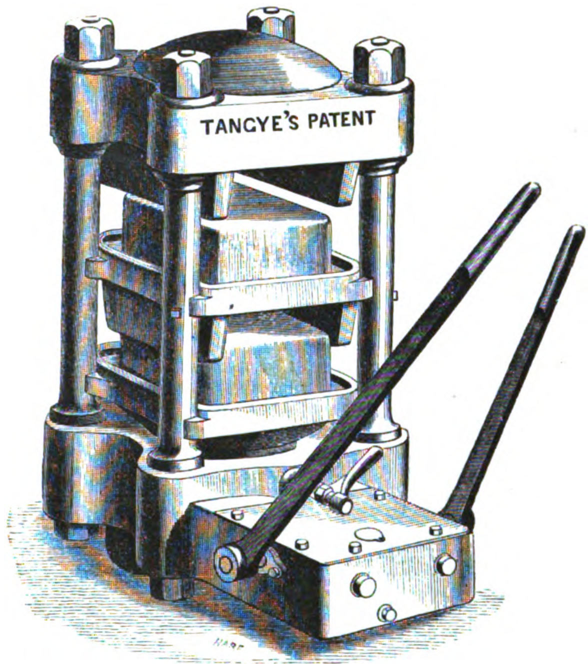
The pump and cistern are contained in the base plate, as described more fully at page 347.

SIZES AND PRICES, INCLUDING SAFETY VALVE COMPLETE.

	Diameter of "Ram."	Power.	Will "run out."	Dist. between Platten and Top when down.	Size of Platten.	Price £	s.	d.
Wrought Iron Cylinders and Rams. No. 1	3¼ in.	15 Tons	10 in.	26 in.	28 × 20½ in.	21	10	0
,, 2	3½ ,,	20 ,,	10 ,,	26 ,,	32 × 22 ,,	26	10	0
,, 2A	4 ,,	30 ,,	10 ,,	26 ,,	32 × 22 ,,	32	0	0
,, 2B	4 ,,	30 ,,	10 ,,	26 ,,	36 × 24 ,,	35	0	0
,, 3	6 ,,	50 ,,	15 ,,	42 ,,	46 × 30 ,,	47	10	0
,, 4	7 ,,	50 ,,	24 ,,	50 ,,	12½ × 12½ ,, / 14½ × 14½ ,,	31	10	0
,, 4A	7 ,,	50 ,,	24 ,,	50 ,,	14½ × 20½ ,,	35	0	0
,, 5	6 ,,	40 ,,	43 ,,	72 ,,	46½ × 37½ ,,	60	0	0
,, 6	7 ,,	80 ,,	15 ,,	42 ,,	46 × 30 ,,	60	0	0
,, 6A	7 ,,	70 ,,	36 ,,	60 ,,	36 × 27 ,,	67	10	0
,, 6B	7 ,,	80 ,,	30 ,,	60 ,,	34 × 34 ,,	65	0	0
,, 6C	7 ,,	70 ,,	48 ,,	72 ,,	66 × 30 ,,	85	0	0
,, 7	10 ,,	200 ,,	18 ,,	36 ,,	36 × 24 ,,	75	0	0
,, 7A	8 ,,	150 ,,	48 ,,	72 ,,	66 × 30 ,,	130	0	0
,, 8	10 ,,	150 ,,	18 ,,	48 ,,	46 × 30 ,,	75	0	0
,, 9	10 ,,	200 ,,	20 ,,	64 ,,	48 × 42 ,,	95	0	0
,, 10	10 (with two pumps).	200 ,,	36 ,,	72 ,,	60 × 42 ,,	130	0	0
,, 11	12 ,,	300 ,,	12 ,,	36 ,,	36 × 18 ,,	120	0	0
,, 12	10 ,,	200 ,,	36 ,,	72 ,,	64 × 42 ,,	135	0	0
,, 13	10 ,,	150 ,,	54 ,,	72 ,,	96 × 48 ,,	170	0	0

For extra height between platten and top, 2*s.* 6*d.* per inch up to No. 5, and 3*s.* 6*d.* per inch above. For extra "run out" of ram, prices will be given on application.

If with two pumps, £3 extra, up to No. 6B; above, to No. 9, £6 extra.



PATENT HYDRAULIC PRESS,

FOR LINSEED, OLIVE, AND OTHER OILS.

	Price. £	s.	d.	Weight. cwt.	qrs.	lbs.
150 Tons, with 2 pumps	45	0	0	21	0	0
200 Tons, ,, 2 ,, ...	55	0	0	28	0	0

These presses are adapted for use where moderate quantities are required; and they are sent out complete, requiring no erection, and are ready for use when the cistern is filled with water.

HYDRAULIC PUMPS FOR POWER.

A pair of hydraulic pumps are worked from a wrought-iron crank-shaft running in gun-metal bearings, and fitted with a fly-wheel on one end, and fast and loose pulleys on the other end; the connecting rods are of wrought-iron, with gun-metal heads and lock-nuts. The whole is mounted on a strong cistern, which serves as a foundation-plate and a reservoir to supply the pumps with oil or water.

Price as described, complete, with safety valve and foundation bolts . . £50 0 0

BEST HYDRAULIC LEATHERS FOR PRESSES AND PUMPS.

Best Single Cupped Leathers for Press Pumps, price 10*d.* per inch.
Best Double Cupped Leathers for Hydraulic Presses, at 1*s.* 2*d.* per inch.

OIL MILL MACHINERY.

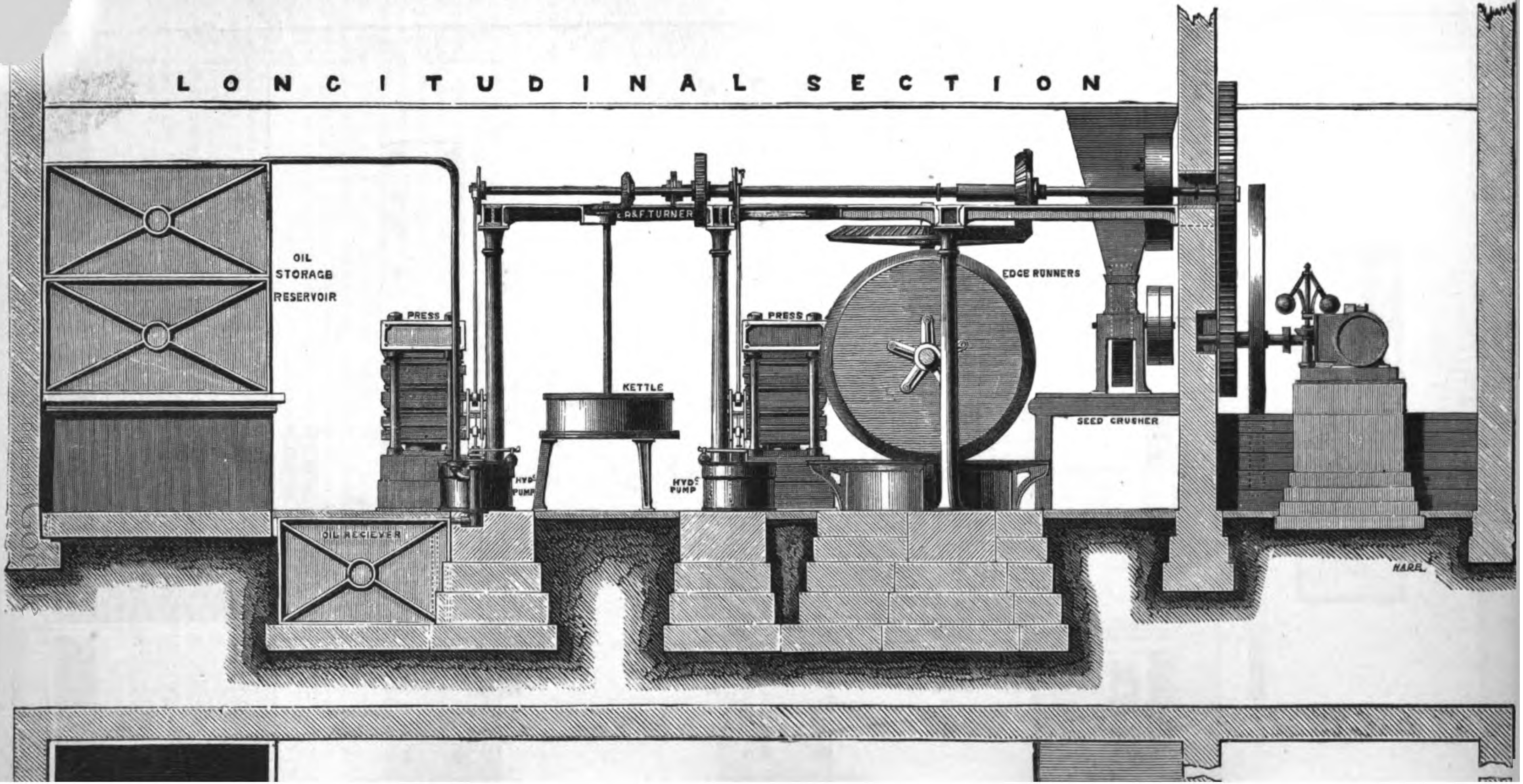
THE process almost universally adopted for extracting oils from seed, nuts, &c. is that illustrated and described in the following pages; in some operations special appliances are required, but they are exceptional, and for the present purpose a description of a small mill of the most recent construction for working linseed, rape, and cotton seed, with the cost of the machinery, the power required, and the working results obtained, will perhaps be more generally useful than an extended treatise which could not be exhaustive under all circumstances.

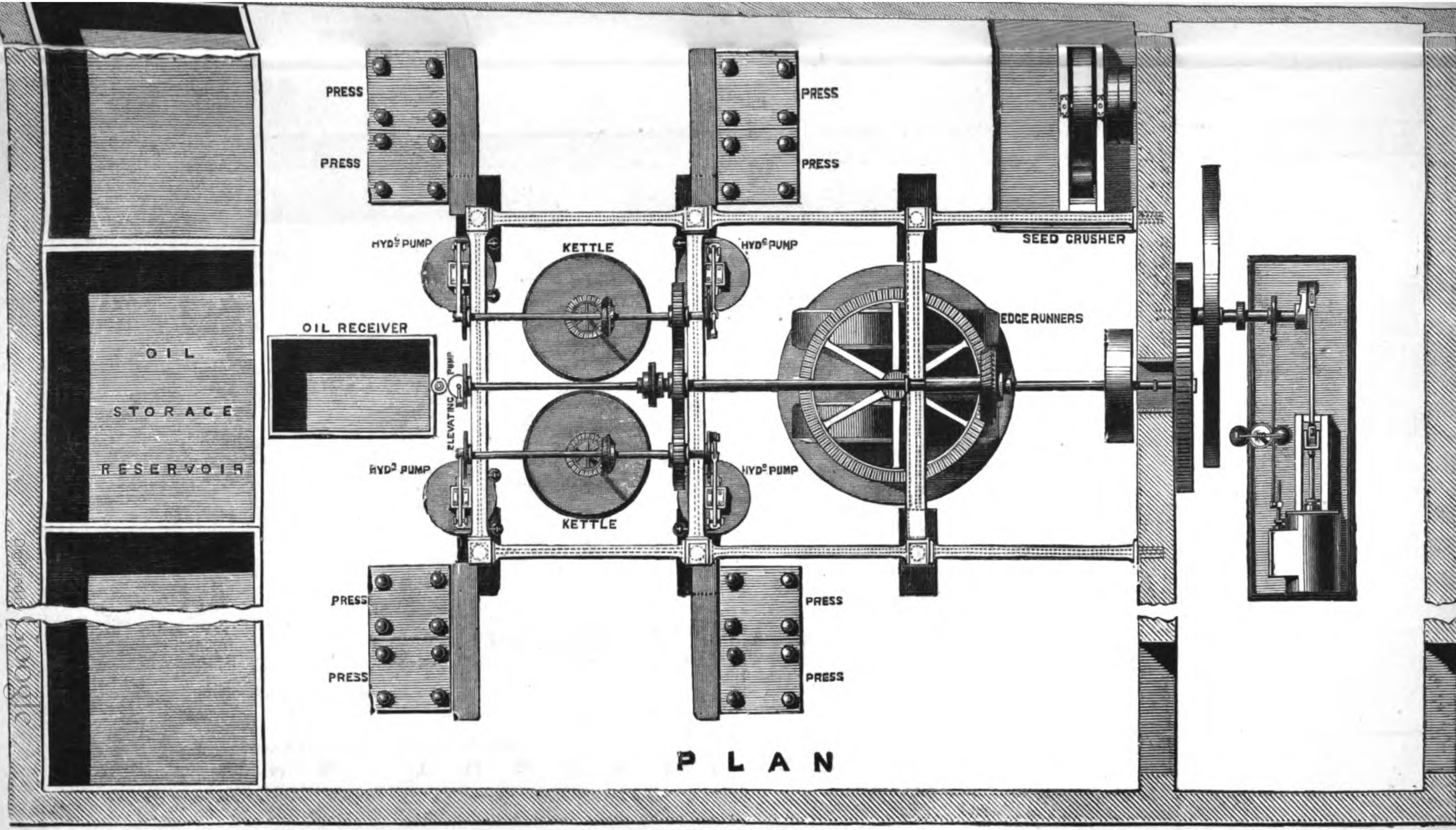
When the building is erected to receive the machinery, practical experience has proved the arrangement shown to be convenient and economical, but if an existing building has to be used the arrangement of machinery must often be modified; in all cases, however, care should be taken to let the seed pass from one operation to another with the smallest possible expenditure of manual labour. The seed is first passed through the Roller Mill, illustrated at p. 355, to crack the shell. This is a very powerful Mill, and consists of a large cast iron roller working in contact with a smaller one, with apparatus for adjusting them; the journals are all of great length and run in gun-metal bearings, which are necessary to withstand the great strain to which they are subjected and to have the requisite durability. It will crush three to four quarters of seed per hour, and is sufficient for three pairs of presses; the mill should be fed from a large hopper beyond which is a screen for taking out stones &c. to prevent damage or breakage to the mill; it is driven by a strap or by gear as may be most convenient, and the power required is about ten *indicated* horse-power.

The grain falls from the mill into a Shoot for charging the Edge Runners. These consist of a pair of vertical stones usually 7 ft. 6 in. diameter and 1 ft. 6 in. thick, revolving on a horizontal bed-stone; centrally with the bed-stone is a vertical shaft through which the axis of the stones pass, and this shaft being driven by bevil gear, the stones (or "Edge Runners") receive a double motion, one on their own axis, and the other that by which they are carried round and round the bed-stone. The central shaft is slotted vertically to allow the Runners to rise over heaps of grain without straining, and the bed-stone is surrounded by a saucer-plate to retain the grain which is collected under the stones by rakes or sweepers attached to the vertical shaft, and revolving near to the surface of the bed-stone, so that the grain which is spread by the motion of the stones, is collected in a ridge in the line of motion; one of the runners is set nearer to the vertical shaft than the other, giving each stone a separate track; they are also fitted with a sweeper capable of being lifted and lowered on to the bed for removing the grain when sufficiently ground. One pair of such stones will crush three to four quarters of seed per hour, which will supply three pairs of presses; they should be driven at 19 revolutions per minute, and the power required to drive them is about ten actual horse power. In some mills the rollers before described are not used, and the seed is at once subjected to the Edge Runners, but hard and smooth grains are liable to slip from beneath the runners, and thus require much more time in the mill. The bruised grain is next transferred to the "Steam Kettle," which consists of a circular cast iron steam jacketted pan, divided into two compartments one above the other, a vertical shaft passes through the pan, and is fitted with a stirrer to prevent the grain becoming caked by the heat; the grain is first put into the upper compartment, and after a time it is let down by a slide into the lower one, more seed being put in the top; after the seed is raised to the proper heat in the lower compartment, a slide is opened in the bottom of the pan, and the seed falls into a funnel-shaped hopper, on which is hooked a hair-bag of the right dimensions for forming the cake, this operation is usually conducted by a boy under charge of the pressman; one of these kettles is required to each pair of presses; the hair-bag of seed is handed over to this pressman, who places it in one of the seed-boxes of the press.

The engraving at p. 355 represents a pair of hydraulic presses and their pumps, each press containing four seed-boxes capable of making four 8 lb. cakes; the rams are 12 in. diameter, the press pillars are of solid scrap iron turned bright. The pumps are 1 in. and 2 in. diameter respectively, and of gun-metal, mounted on a cast-iron circular tank, complete, with improved stop-box for changing the pressure from one press to the other, or retaining the pressure on one press whilst the ram of the other is rising, which effects a great saving of time. Wrought-iron rocking beam, with double slings to pump rams, safety valves to small and large pumps, and self-acting relief motion to large pump, connecting-rod ends ready for shutting up to connect them with the over-head driving shaft; these pumps require about two actual horse-power to drive them. A press should be charged and discharged every ten minutes, and each box containing 11 lbs. of linseed produces a cake 7½ lbs. weight, and 3½ lbs. of oil,—therefore 2,240 lbs. of linseed will produce about 1,528 lbs. of cake, and 712 lbs. of oil, or a plant of machinery

LONCITUDINAL SECTION





PLAN OF OIL MILL, AS DESCRIBED AT PAGES 352 AND 354.

consisting of one roller mill (p. 355), one pair edge runners, two steam kettles, and four pairs of presses, driven by a twelve horse-power engine, will work off 100 quarters of seed every 24 hours, requiring the following hands :—

	£	s.	d.	
One engineman	0	5	0	per day.
Four pressmen	0	18	0	„
Four boys	0	8	0	„
Man to rollers and stones	0	4	0	„
Manager or foreman	0	7	6	„
Coals, 36 cwt.	1	2	6	„
Oil, &c.	0	5	0	„
Interest on plant	0	8	4	„

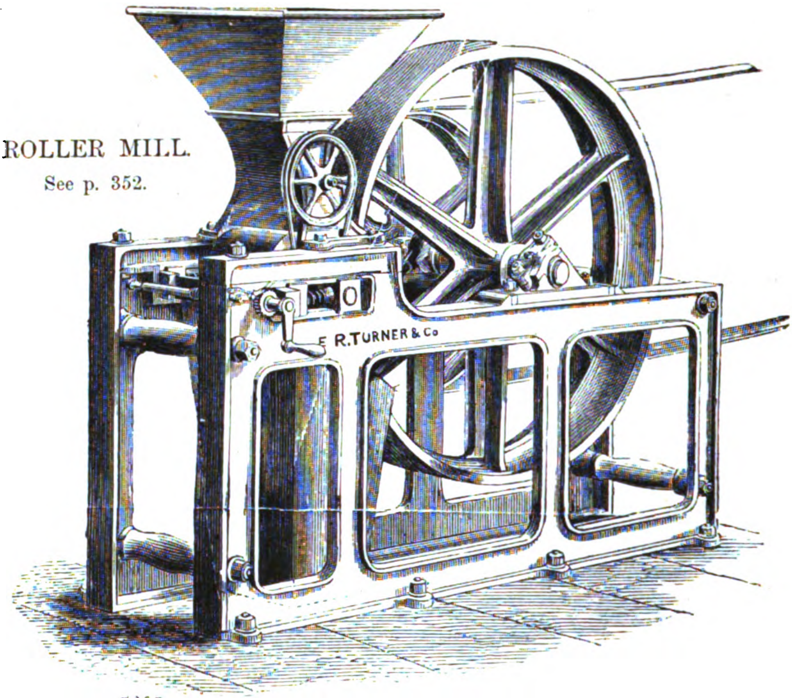
The above rates are taken from a mill in work in London where coals, labour, &c. are expensive; in many places these are obtained at much lower rates, and a corresponding reduction is effected in the working expenses.

The cost of this plant will be about as given below :—

	£	s.	d.
*One (nominal) twelve-horse-power engine and boiler with all fittings and connections	300	0	0
One pair of seed rollers	63	0	0
One pair of edge runners	120	0	0
Two steam kettles	66	0	0
Four pairs of presses and pumps	880	0	0
One wrought-iron tank	10	0	0
One lift and force pump to raise oil to fining tank	10	0	0
One seed screen	15	0	0
One sack tackle	20	0	0
Shafting and gearing for driving the whole of the above	100	0	0

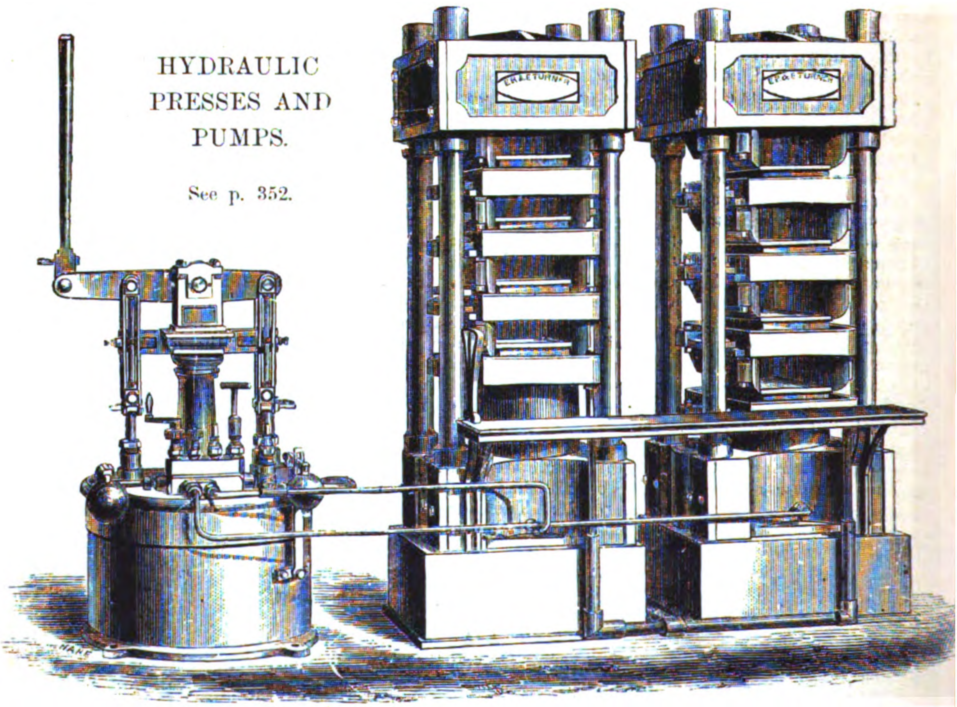
From the above estimate and the prices given with each engraving, the approximate cost of a mill of any size can readily be estimated. Although the process, of working different seeds and vegetable matters may vary slightly, one or two special machines may be mentioned as having been constructed. In working the castor oil seed, the seed has to be taken from its outer shell, without bruising the second skin, because if this is bruised the shell will, from the softness of the seed, adhere to it and naturally interfere with the operation. The machinery for this purpose consists of a conical sieve, rotating on an horizontal axis, and the periphery of the sieve is divided into three divisions, each division of different mesh, the finest being at the small end of the sieve, and the coarsest at the large end; below this are placed a pair of rollers of the same length as the sieve, and with their axis parallel to the shaft of the sieve; the rollers are also divided into divisions corresponding to the sieve above it by being turned to slightly varying diameters; thus the part of the rollers under the finest part of the sieve would be the largest diameter, and the part under the coarsest, the smallest diameter; therefore, when the seed is fed into the inside of the conical sieve from a hopper at the end, the smallest seed passes through the first and finest division, and falls into the part of rollers being from their largest diameters closest together, and the other sizes as they travel through the screen are treated in the same manner, the stones, &c. passing out at the other end. The shell of the seed when cracked by this machine falls off readily without damaging the kernel and is easily separated. The press used for expresing the oil has usually a circular perforated box, with an oil channel around it fixed on to the top of a small hydraulic ram; the seed from its soft nature requiring only a small amount of power, a projection from the head of the press fits the circular box, and as the ram rises, the seed is compressed and the oil flows through the perforations on to the channel, and is conducted to the tank. Cotton seed can be worked by the same machinery as that described for linseed, but there is a great advantage in cleaning the cotton perfectly from the seed which (however well ginned) adheres to it, rendering the cake of but little value for feeding purposes: this may be accomplished perfectly by using machines similar to those described for pearling barley at p. 326. The cake should also be ground and worked over a second time, and the temperature of the mill kept as high as possible.

* The power given above is nominal; the ACTUAL power would be about 30 H. P.



ROLLER MILL.

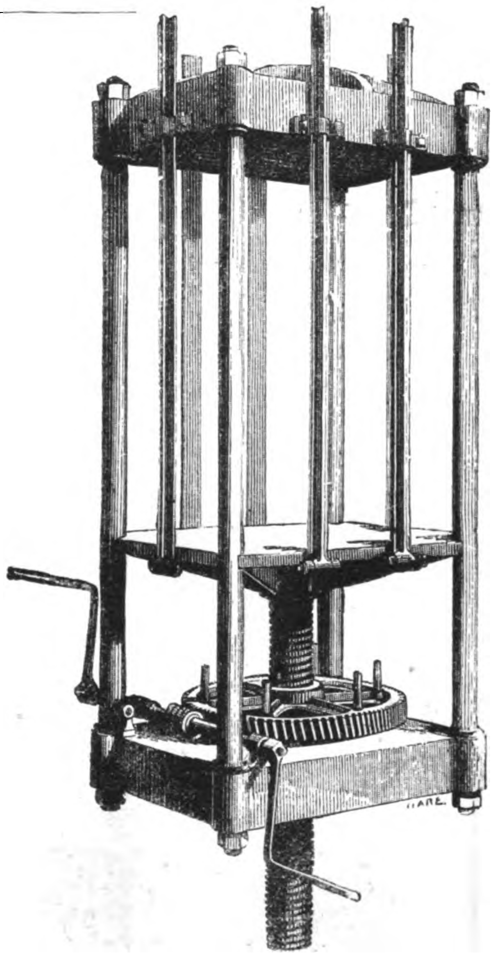
See p. 352.



HYDRAULIC PRESSES AND PUMPS.

See p. 352.

SCREW PRESS WITH SLIDING BARS



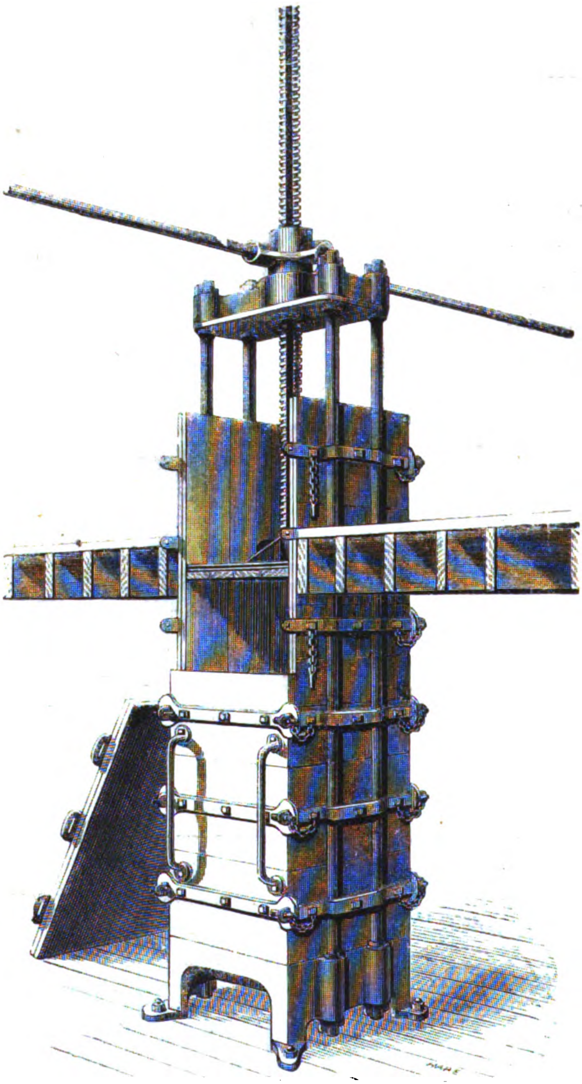
And Side Irons to slide up and down with the table. When run down, the irons on one side may be let down so as to form an inclined plane, on which the bale may be shifted from the Press.

The worm can be thrown out of gear, and the screw run either up or down quickly, by means of the handles on the rim of the wheel.

Diameter of Screw.	Size of Table.	Range of Screw.	Distance between Platten and Top when down.	Approximate Weight.	Approximate Cubic Measurement.	Prices.		
Inches.	Inches.	Inches.	Feet.	Cwt.	Feet.	£	s.	d.
P—5	30 x 30	30	5	36	22	50	0	0
Q—5	46 x 36	42	7	42	20	59	0	0
R—6	30 x 30	36	6	42	24	59	0	0
S—6	66 x 30	48	6	90	...	80	0	0
T—7	66 x 30	48	6	130	...	120	0	0

COST OF PACKAGE, FOR EITHER KIND OF PRESS, AVERAGES ABOUT 3 PER CENT ON THE ABOVE PRICES.

HAND-POWER SCREW PRESS, FOR WOOL OR COTTON.



The Hand Screw Press here illustrated is suitable for small estates where hydraulic presses are not required. It is adapted equally for wool or cotton, and is simple and inexpensive. The top, and bottom, and press-plate are of cast-iron, the press pillars of wrought-iron cottered top and bottom; the screw is of best fagotted wrought-iron, 3½ inches diameter, with strong square threaded machine-cut screw; the nut is so arranged that it is always the same height from the upper floor, where the wool or cotton is filled into the press.

The clear inside dimensions of the baling-boxes are usually 2 ft. 3 in. square, by 7 ft. high, to press down to 3 ft. 6 in., and they are of hard wood, two thicknesses placed crosswise, and strongly bound with iron and fastened with cotters; the doors at front and back have iron handles, and take down for convenience of binding and turning out the bales after being pressed, and the bottom plate and under-side of pressing-table are lined with timber, with spaces left for holding the baling-hoops or ropes.

The approximate weight of such a Press is 26 to 28 cwt., and the price is about £50.

SHEEP AND WOOL WASHING MACHINERY.

ALTHOUGH Wool Washing Machines have long been extensively used in all woollen manufactories, their introduction into the Colonial and other large sheep farms, is of but comparatively recent date. The great importance of thoroughly cleansing the wool, is, however, becoming so apparent, that the demand for a proper apparatus for the purpose, is constantly increasing. The authors have under consideration at the present moment, an arrangement of machinery which they believe will materially reduce the labour and cost of sheep washing, and produce an excellent sample of clean wool; and they much regret that they are unable to give details of the plan in the present edition.

It has been a common practise to send wool to market "*in the grease*," that is, as it has been shorn and with the natural "yolk"* and dirt, and without being subsequently cleaned.

Scoured wools are those which have been washed and scoured after shearing, and they fetch the highest price in the market.

Greasy wool generally wastes about half its weight, and as the purchaser has to consider the cleanliness of the wool and the quantity it will waste, and regulate his price accordingly, it necessarily follows that wool in this state fetches only about half the price of scoured wool. In addition to this there is the item of freight paid on unproductive weight, and the risk of deterioration in quality.

It therefore becomes a serious question with the producer or exporter, whether it is not more economical to put up the appliances necessary for washing the wool before shipment. "Hand washing," as it is termed, in large farms where sheep are grown principally for their wool, is a work involving great labour and expense, but these may be very materially reduced by a proper arrangement of pumping machinery worked by a small steam engine (where no sufficient natural fall exists), and this, with suitable washing troughs, form the basis of the plan alluded to, as being now under the authors' consideration.

WOOL WASHING MACHINES.

THESE machines may be divided into three classes :—

1st. Those without feeders, tumblers, or fixed and swing rakes, but *with* lifting cylinder or automaton lifter, delivery apparatus or fan, and squeezing rollers.

2d. Those having two or more rakes and tumblers, in addition to the motions above named.

3d. Double machines, or any two of those above named.

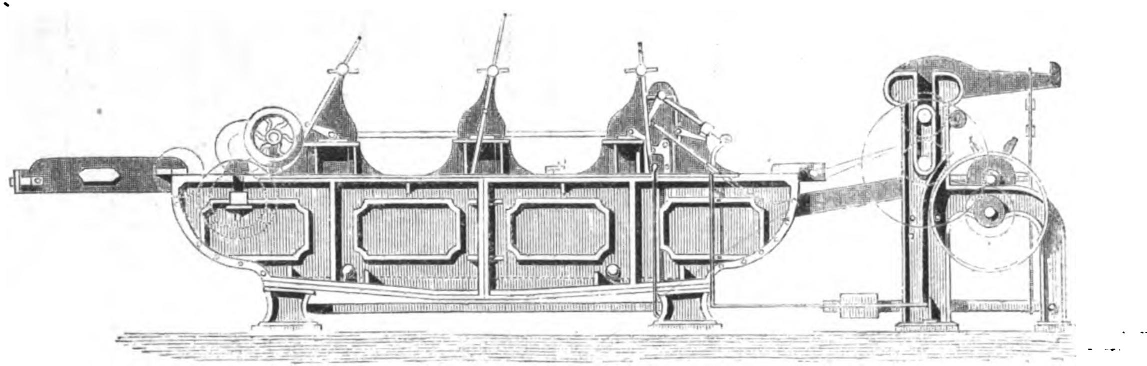
The machine first named consists of a cast iron rectangular vessel, (or "bowl," as it is usually termed), containing water at a temperature of about 120° in which the wool is placed and agitated by hand to get rid of the animal grease; clean water is then admitted, and the wool is lifted by the automaton lifter and placed on an endless web, at the end of which a pair of rollers giving a pressure of from 6 to 9 tons, squeeze the moisture out of the wool.

These machines are made in three sizes and may be advantageously used where the quantity of wool to be washed is not large, and where the cost of the more complete apparatus is an important consideration. One advantage which these machines possess over the more complete "Rake Machines" is, that the wool can be left in steep as long as may be desired.

Size.	Length of Bowl.	Width of Bowl.	Diameter of Delivery Fan.	Price.	Cost of Packing.	Power required.
No.				£ s. d.	£ s. d.	
1	14 Feet.	30 Inches.	20 Inches.	75 0 0	5 7 6	1 H.P.
2	15 ,,	36 ,,	24 ,,	105 0 0	7 17 6	1 ,,
3	18 ,,	36 ,,	24 ,,	115 0 0	8 12 6	1 ,,

NOTE.—The bowl of No. 2 machine is equal in capacity to a three rake complete machine, without tumbler; and the bowl of a No. 3 machine is equal to a four rake machine, without tumbler.

* "Yolk" is a secretion from the glands of the skin, of a soapy character and soluble in water: it serves to nourish the wool, and by matting the fibres together forms a protection against wet and cold. It exists in the greatest quantity about the breast and shoulders of the animal, where the best wool is produced, and it differs in quantity in different breeds, but averages about half the weight of the fleece. If the yolk is left in the fleece, it may ferment and render the wool harsh, and thus reduce the value.



WOOL WASHING MACHINES—*continued.*

Machines of the second class are adapted for washing large quantities of wool, and are fitted with rakes which perform the work of the hand agitation, and are made in 4 sizes as under, viz :—

	£	s.	d.
No. 4. Two rake, with brass covered tumbler, equal in capacity to a three rake machine, without tumbler, new patent lifting cylinder, with brass interior, powerful press rollers, equal to a pressure of 9 tons: 24 in. diam. delivery fan, and small scraper fan to top roller complete. 18 ft. × 5 ft. 6 in. wide .	132	0	0
No. 5. Three rake, ditto, ditto, equal in capacity to a four rake machine, without tumbler, 36 in. wide roller as in No. 4 machine. 21 ft. 6 in. long, × 5 ft. 6 in. wide	155	0	0
No. 6. Three rake, ditto, ditto, brass interior to lifting cylinder, extra strong shafts, and double-sized brass bearings throughout; very powerful rollers capable of sustaining 13 tons, 24 in. delivery fan, and small scraper fan to top roller complete	180	0	0
No. 7. Four rake, ditto, ditto, equal in capacity to a five rake machine, without tumbler, generally similar to No. 6. 24 ft. 6 in. long, × 5 ft. 6 in. wide . .	200	0	0

The swing and fixed rakes may be made with brass teeth at 30/ per rake extra.

Any of the machines, Nos. 4 to 7, can be fitted with Mitchell's Patent Cloth Covered Top Roller at an additional cost of £16 10*s.*

The squeezing rollers can be covered with brass if desired, ¾ in. finished thickness, at £30 per roller. Packing any of the above machines, 7½ per cent on their cost.

The "Patent Automaton Lifter," mentioned before, is specially for wools, cottons, &c. of short staple, its action being precisely like that of a workman lifting the wool with a fork and depositing it on the travelling web which conveys it to the squeezing rollers ; but it will also work wools of moderate length of staple. The prices are the same as if fitted with lifting cylinder, see page 359.

The third kind, or double machine, consists of any two of the single machines worked together, end to end, the first being used for the scouring only, after which it is passed through the first squeezing rollers, and delivered into the second machine for the finishing process without manual labour. A third machine is sometimes added to these and used for rinsing with clean water only. The second machine is placed at a slightly higher elevation than the first, and the steeping liquor is run from the second machine to the first machine, before it is discharged ; pipes and valves are fitted for this purpose.

Although the power required to drive each machine will certainly not exceed that indicated, where an engine has to be erected it is desirable to put one down of not less than 6 nominal horse-power, because it can be worked almost (if not quite) as economically as one of less power, and experience has shown that almost invariably the plant has been extended. The surplus power may be used either for working pumps or for driving fans for drying, as described further on, whilst the steam from the boiler is always wanted for heating the liquor in the washing machines, &c.

The price of a double machine is that of any two single machines.

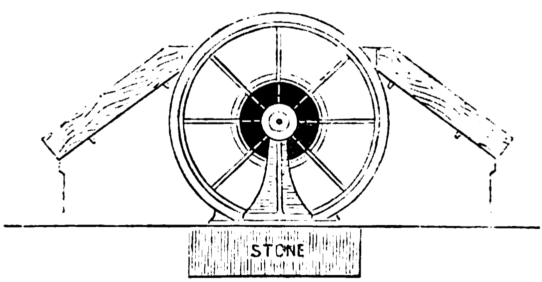
A three rake double machine will scour and wash 5,000 lbs. of wool per day of 10 hours.

DRYING APPARATUS.

In some factories the wool is placed in closets or stoves, heated by steam pipes to a temperature of 100° to 120°, well ventilated to allow the moist vapour to escape as formed, but this plan has been to a considerable extent superseded by the use of the "exhaust apparatus," its moderate first cost and the ease with which it is erected being great recommendations for its adoption in the Colonies.

The apparatus consists of a rectangular frame about 12 in. high, the top being sloped from the centre towards the sides, and perforated to receive the washed wool. It is spread evenly over the whole surface, care being taken that no place is left uncovered. An exhaust fan fixed at one end of this frame is then set in motion and a current of air (due to the size and speed of the fan) is *drawn through* the wool and the moisture is thus extracted.

Drying apparatus, 12 ft. × 9 ft. with fan complete, price £60.
Ditto ditto 18 ft. × 9 ft. ditto ,, 80.



END ELEVATION OF EXHAUST DRYING APPARATUS.

The general arrangement of this apparatus is similar to that shown in the subjoined engraving.

In some climates, and for drying certain kinds of wool a hot air apparatus may be required. Under such circumstances a range of steam pipes are placed under the perforated top already described, and supplied with steam from the boiler or from the exhaust of the engine.

Instead of an exhaust fan a blowing fan is used, which forces a large volume of air through the wool, after being heated by passing around the steam pipes, and the injurious effect of heated air is thus materially decreased.

Drying apparatus, 12 ft. × 9 ft. complete with steam pipes and fan, 30 in. diameter, price £88.
Ditto 24 feet × 9 feet ditto ditto £145.

STONE-BREAKING AND SEPARATING MACHINERY.

To prepare road metal, and ballast for railways on a large scale, a plant of machinery similar to that designed and erected by the authors for the Groby Granite Company, will be found economical in cost, and the good practical results obtained induces them to give a description of the works and of the arrangement of machinery.

The works are erected on the top of an incline alongside the quarries, and the machinery is driven by a pair of horizontal high-pressure engines each of 15 horse-power, (nominal), fitted with expansion gear worked from the governors; the steam is taken from two Cornish boilers, *each* capable of supplying both engines.

At the top of the incline is a winding drum worked by patent frictional gear, and on each side of it are two Blake's Patent Stone Breakers, of the larger size, (see p. 205), which are driven by straps from the fly-wheel of each engine, the fly-wheels being outside the engine-house to prevent injury to the machinery from dust and grit.

The winding drum hauls the loaded trucks up the incline and lands them on a tipping platform between the stone-breakers; this platform is balanced, and one man can easily tip the loaded or full trucks on either side, and the contents of the trucks are deposited on sloping platforms adjoining each breaker.

One man at each breaker pushes the stones forward to fall between the jaws of the machines, and it is broken into cubes usually of about 1½ or 2 in. on each side. From the breakers the materials fall into revolving screens, which are constructed of a series of wrought-iron rings, spaced about ¾ in. apart, for about half the length of the screen, and 2½ in. for the remainder. The inner edges of these rings are slotted to receive ½ in. square bars placed longitudinally and spaced so as to form respectively ¾ in. and 2 in. mesh. The two halves of the screen have a spur-ring between them into which gears a spur-pinion on a shaft driven by a strap and pulley from the breaker-shaft.

The fine portions are taken out by the ¾ in. mesh and conducted by shoots into trucks on the company's line of railway, which is about 20 feet below the level of engine-house. The 2 in. stuff passes in a similar manner to the trucks placed to receive it, and the small proportion which is above that size is thrown out at the end of the screen and is returned to the breakers.

From the foregoing description it will be seen that in the breaking process the employment of manual labour is reduced to the minimum, and the trucks being loaded at the quarries and brought to the foot of the incline by small locomotives, the materials are reduced to the required size, sifted, separated and loaded into permanent way trucks for sending to their destination, entirely by mechanical appliances, without having to be again handled.

The cost of the whole of the plant is about £2,000, exclusive of carriage and erection, and it will break about 140 tons of the hard Leicestershire Granite per day of 10 hours, the hands employed being,—

1 engine driver, who stokes and works the incline.
2 men at the breakers (one to each).
2 men below trimming in the permanent way trucks.

e average yield is 80 to 85 per cent. of road metal, and 15 to 20 per cent. of small stuff which is used for footpaths, concrete, &c.

For contractors, highway boards, and for temporary use, &c. a stone-breaker, driven by a portable engine and fitted with a fixed inclined screen, will be found an economical and labour-saving tool.

STONE CUTTING AND DRESSING MACHINES.

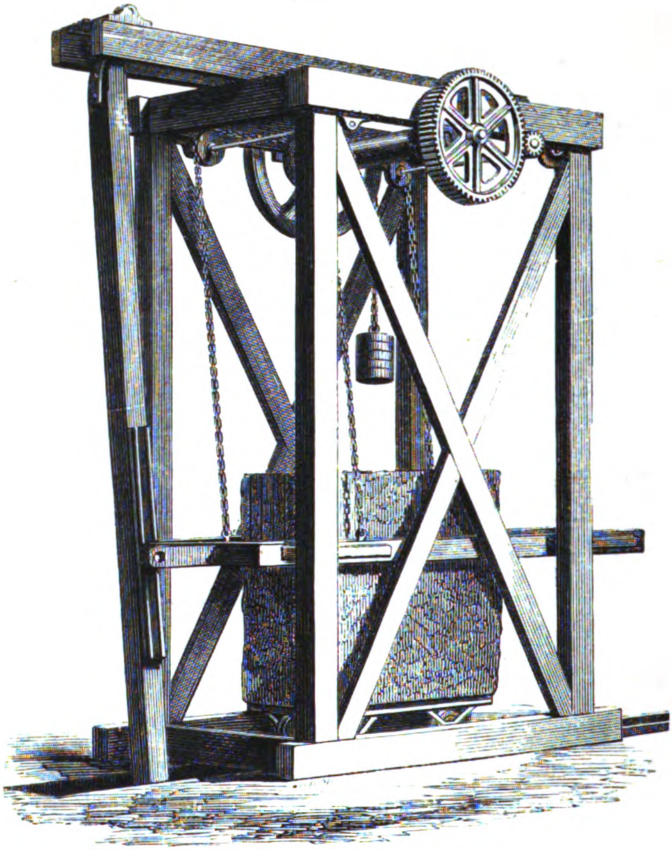
ALTHOUGH many attempts have been made to apply machinery as a substitute for manual labour in the slow and expensive process of dressing the harder class of stone, such as granite, &c. to the various shapes required for structural purposes, there is at the present moment perhaps no machine which, in practical working, has satisfactorily fulfilled the necessary conditions. The authors have been engaged for some months past in experimental trials of machinery for the purpose indicated, and the results obtained lead them to think that the difficulties can be overcome, and that machinery can be constructed which will dress the hardest as well as the softest stone of regular or irregular form to a face at least equal to that produced by hand, and at a speed quite unattainable by hand labour; but the mechanism in question not having yet been tested on a large scale, it is perhaps desirable to refrain from publishing experimental results, which may not be realised in extensive working. The authors will, however, furnish any information on this subject if such should be desired.*

For working the softer kinds of building stone, the stone sawing and rubbing machines hereafter illustrated and described in detail have been extensively employed, and the saving in time and labour effected by these machines is so great, that they are now used in most well-appointed builders' and masons' yards, as well as in the preparation of stone for most works of any magnitude on the site of the building itself.

The machines are usually driven by a portable steam engine or by a hoisting engine; in the latter case the arrangement frequently comprises a circular saw bench, general joiner, or other machinery, somewhat as shown at pp. 14 to 17, the advantage of this arrangement being, that one engine and one driver suffices for working the machinery and hoisting all the materials required in the structure; another advantage is, that the rough materials being delivered direct to the work, the cost of several removals and the risk of the dressed stones being broken or disfigured in transit is avoided.

* TUNNELLING MACHINERY.

The authors have also given much attention to the construction of machinery for driving headings, sinking shafts, &c. in the hardest rock, and they will shortly test the apparatus in tunnelling on a large scale, but the considerations indicated above induce them to defer publishing details until they are in a position to state the results obtained in actual work.



STONE SAWING MACHINE.

THE machine illustrated consists of a rectangular timber frame, which is usually supplied by the purchaser, with a wood pendulum or connecting-rod, slung from a pair of cast-iron blocks on the upper part of the frame, the lower end being in a pit and driven by a line of shaft underground, with fast and loose driving pulleys. The reciprocating motion is obtained from a disc crank fitted with a connecting-rod which is attached to the lower end of the wood pendulum above-named, and several of these saw-frames can be driven from one shaft.

The wood pendulum has planed cast-iron grooved plates, in which are fitted two cast-iron slide blocks, connected to the saw-frame by round pins, the vertical movement of the blocks in the slides allowing the saw-frame to rise or fall.

The swing frame is formed of cast-iron sides with wrought-iron cross-heads, one pair being adjustable to take saws of different lengths; the sides are planed at that portion of their length which comes opposite to the vertical uprights, the inside faces of which are provided with planed strips of suitable length. The swing frame is hung by four chains passing over pulleys and attached to a chain-barrel at the top of the rectangular framing; the hauling-wheel on the pinion-shaft has a light chain, loaded to counterbalance the weight of the swing frame as closely as may be desired, and this gives the proper feed to the saws.

A great saving in time is effected by laying a line of light rails from the storage ground to the saw frame; the stone can then be laid on a low trolly with flanged wheels and run under the saws. If two or more trolleys are provided, a fresh stone can be ready the moment that which has been sawn is removed.

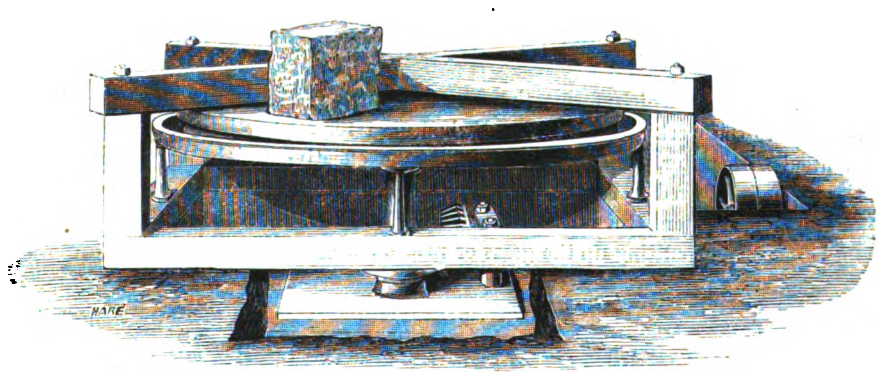
The cost of the flanged wheels, wrought-iron axles, and pedestals, is about £3 per set.

An iron or wooden water tank should be placed on the top of the framing, and fitted with a perforated pipe reaching across the centre of the machine.

The price of the ironwork complete, consisting of cast-iron side frames, guides and blocks, upright iron straining bars, bottom shaft with fast and loose pulleys and fly-wheel, 2 pairs of clips for setting the saws, 15 pairs of saws, buckles, and pins, 24 steel keys, the hauling wheel, gear, shafts, chain-barrel, pulleys, chain, chain-wheels, and balance-weights necessary for hanging the swing frame.

Size of Swing Frame.	Price.	Weight about	Diameter of Driving Pulley.	Number of Strokes.	Power required.
	£ s. d.				
5 ft. × 10 ft.	90 0 0	3¼ tons.	5 ft. 0 in.	90 per min.	2 H. P.
6 ft. × 12 ft.	100 0 0	4 "	5 " 6 "	80 "	2 "
7 ft. × 14 ft.	115 0 0	4¾ "	6 " 0 "	70 "	3 "

For permanent use, and for slate and marble works, &c., the frames are frequently made of iron throughout, and the prices are about double those above quoted.



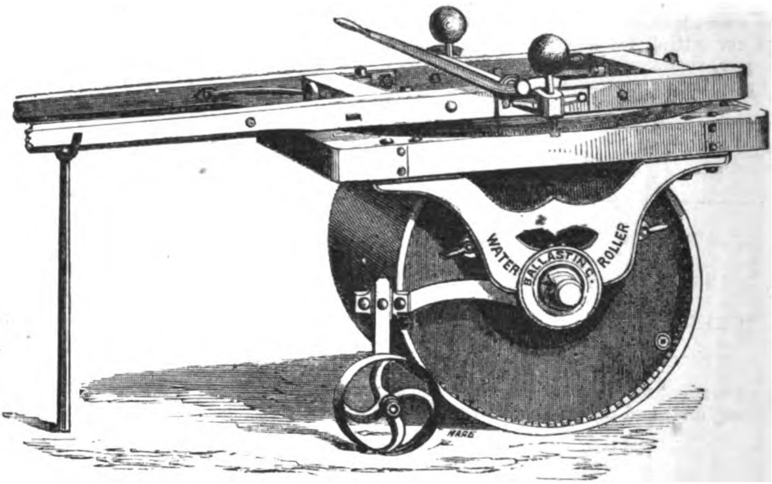
STONE RUBBING OR POLISHING MACHINES.

A MASSIVE cast-iron disc carried on a vertical axis is driven from below the ground-line by a pair of bevil wheels and a horizontal line of shaft fitted with fast and loose pulleys. A circular trough, supported on four cast-iron columns, is placed around the periphery of the disc to catch the waste water, sand, &c., running from it, and thus protect the working parts below.

Two timbers at right angles with each other are firmly bolted to the lower timbers, and just clearing the upper surface of the rubbing disc; these timbers divide the disc into four quarters, each of which can be filled with stones to be dressed, and they serve to hold the stones from revolving with the disc or rubbing plate.

For the purpose of showing the toe-step, mode of fixing, &c., the engraving represents the ground as having been removed. As in the saw-frames, the timberwork is usually supplied by the purchaser, and the price of the ironwork for a rubbing machine with disc 8 ft. diameter, circular trough and pillars, vertical shaft and toe-step, horizontal shaft with pedestals, mitre or bevel wheels, and fast and loose pulley, is £105.

Weight about 4 tons. Power required about 2 H. P.



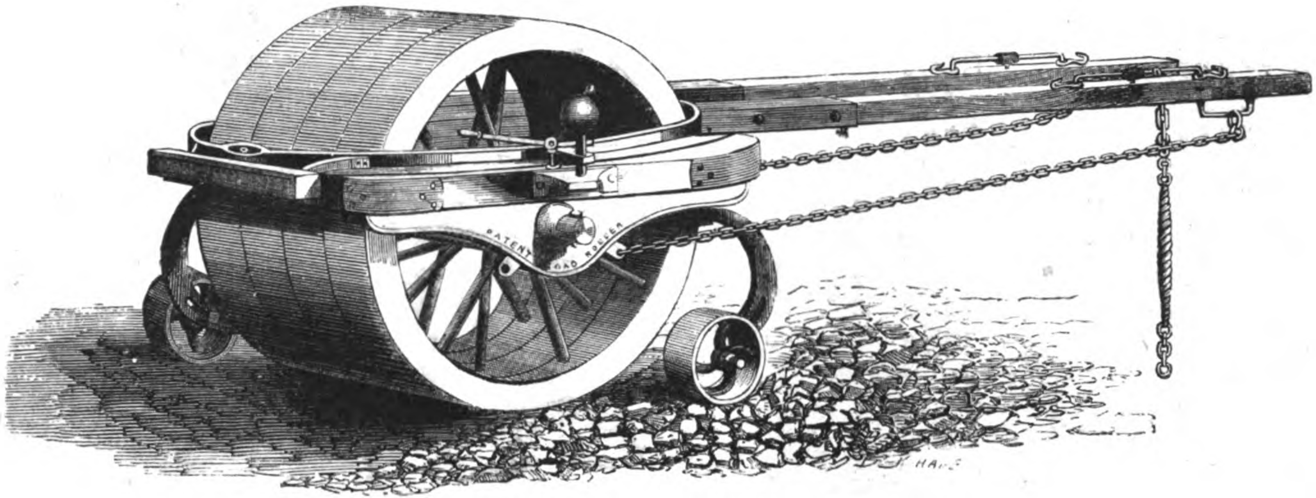
WROUGHT-IRON ROAD ROLLER.

THE Cylinder which forms the Roller is made of wrought-iron of a section suitable to the work to be done, and when used for road rolling, &c. the Cylinder is filled with water, which nearly doubles the effective weight of the Roller;—the water is allowed to run out when the implement is moved from place to place.

With the patent turntable frame the Roller may be taken backward and forward without cutting up the grass or road on which it may be working.

SIZE.		APPROXIMATE WEIGHT.		PRICES.
Length.	Diameter.	Empty.	Full.	
Feet.	Feet.	Tons.	Tons.	£ s. d.
4	3	1¼	2	45 0 0
4	3½	1½	2½	50 0 0
4½	3½	1¾	3	57 0 0
4½	4	2	3¾	65 0 0
4½	4½	2¾	4½	75 0 0

With Turntable Frame, extra £5.
With Break for hilly districts, extra £3 10s.



HEAVY ROAD ROLLERS.

THESE Rollers are made of a series of heavy cast iron rings, with arms and a central boss; the rings are usually 12 inches wide, and about 4 inches thick, but the thickness can be increased when great weight is required. If fitted with the Patent Turntable, the horses can turn in a narrow road or street, ready for the return journey, without moving the position of the roller.

5ft. diameter, 3ft. wide	£65	0	0	Approximate weight,	5 Tons.
5ft. " 4ft. "	85	0	0	" "	7 "
5ft. " 5ft. "	115	0	0	" "	9 "

With Patent Turntable Frame, which adds about ½ Ton to the weight of each size, price extra . £10 0 0

With Break for hilly districts, extra 3 10 0

IRON, STREET WATERING, OR LIQUID MANURE CART.

A STRONG, useful Cart, with the body constructed of best wrought-iron securely rivetted the distributor is also of wrought-iron, perforated, and fitted with gun metal valve and seat, and the driver has entire control over the delivery; the wheels and shafts are of stout, well-seasoned timber. The Pump may be attached to the cart for the convenience of filling from a brook or pond in country districts, and it is fitted with a flexible suction hose and strainer.

No. 1, to hold 300 Gallons	. . . .	Price	£27	10	0
No. 2, „ 250 „	. . . .	„	25	0	0
No. 3, „ 200 „	. . . .	„	23	0	0
No. 4, „ 150 „	. . . .	„	19	10	0

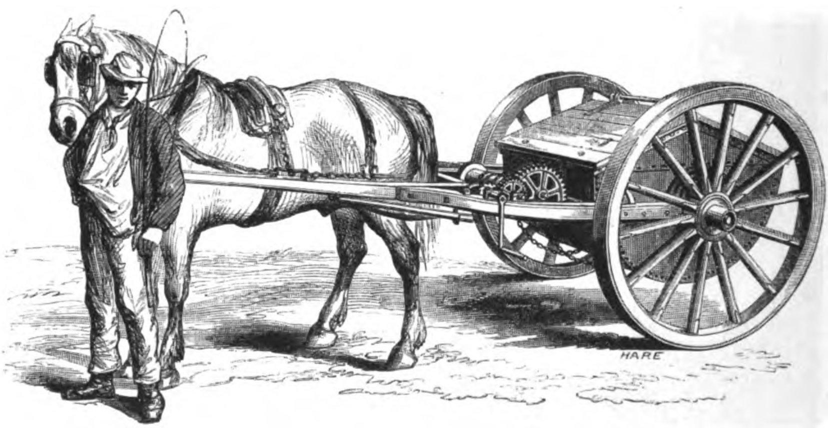
If fitted with Patent Pump, Hose, Strainer, &c.—

Extra for Nos. 1 and 2.	No. 3.	No. 4.
£5 5 0	£4 4 0	£3 10 0

A cheap and useful WATER or Liquid Manure CART is made for FARM PURPOSES. The body of the Cart is of wrought-iron plates rivetted together and mounted on a wood frame, and three wrought-iron wheels, the fore-wheel being made to "lock" or swivel, and fitted with shafts which turn backwards to be out of the way when left in the field, for stock to drink from; a hinged cover in two parts is also included.

No. 1, to hold 200 Gallons	. . . .	Price	£11	10	0
No. 2, „ 170 „	. . . .	„	10	0	0
No. 3, „ 130 „	. . . .	„	8	10	0

If with Wood Spreading Trough, 10*s.* extra.



IRON TUMBLER CART FOR CONTRACTORS, &c.

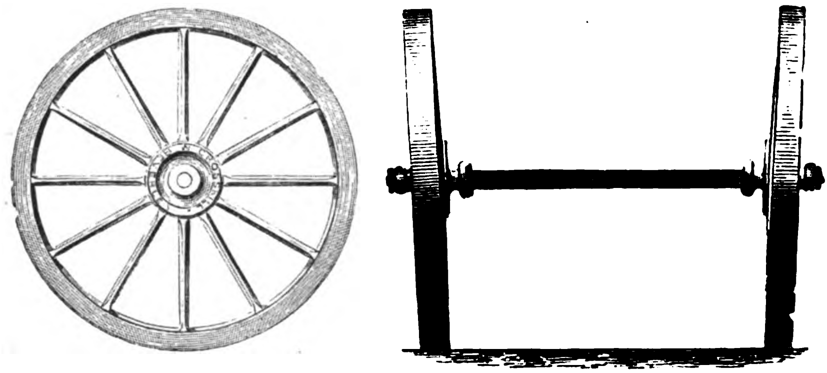
THE body is made of wrought-iron, and is suspended on the axle, so that it can be turned entirely over to discharge the load. This is effected by a chain attached to the back part of the cart body, and worked by a wheel and pinion fastened to the cart shafts as shown.

These Carts are much used for mortar, night-soil, sewage, &c.

Large size, to hold 280 Gallons	. . .	£31	0	0
Small size, „ 150 „	. . .	22	10	0

LONDON MUD CARTS OR SLOP CARTS.

For One Horse	. . . .	£27	10	0
For Two Horses	. . . .	30	0	0



IMPROVED CART WHEELS AND AXLE.

No.	Height of Wheels.		Size of Tire.	Size of Axles.	To Carry a Load of	Price per Set.			Prices of Wheels only, with Wood Naves and without Axles or Bushes, per Pair.		
	ft.	in.		in.	cwts.	£	s.	d.	£	s.	d.
00	4	0	2 by ½	2	20	5	10	0	4	5	0
0	4	6	2½ by ½	2	20	6	0	0	4	15	0
½	4	6	2½ by ⅝	2¼	25	6	10	0	5	0	0
¾	4	6	4 by ½	2¼	25	7	0	0	5	10	0
⅞	4	6	4½ by ½	2¼	25	7	10	0	6	0	0
1	4	6	2½ by ¾	2½	30	7	0	0	5	5	0
1¼	4	6	3 by ¾	2½	30	7	10	0	5	10	0
1½	4	6	4 by ⅝	2½	30	8	0	0	6	0	0
2	4	6	4½ by ⅝	2½	30	8	5	0	6	5	0
2¼	4	9	2½ by ¾	2½	30	7	10	0	5	10	0
2½	4	9	4½ by ⅝	2½	30	9	0	0	7	0	0
3	4	9	3 by ¾	2¾	40	9	0	0	6	10	0
4	4	9	4½ by ¾	2¾	40	10	10	0	8	0	0
5	4	9	6 by ¾	2¾	40	12	10	0	10	0	0
6	4	9	4½ by ⅞	3	60	12	0	0	9	0	0
7	4	9	6 by ⅞	3	60	14	0	0	11	0	0

PRICES OF WAGGON WHEELS AND AXLES, PER SET.

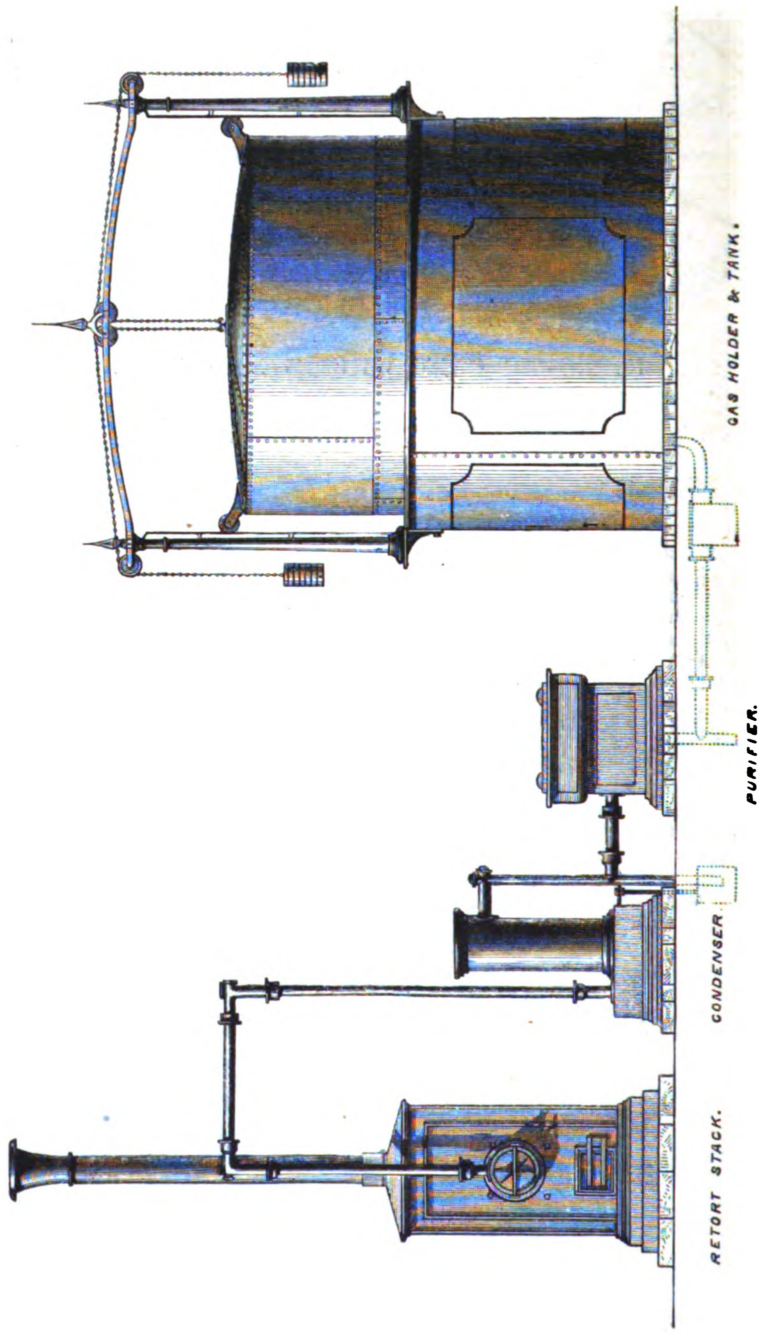
Wheels 4 ft. 9 in. and 3 ft. 4 in. high; Tire ¾ thick, for 3 and 4 tons; and ⅞ for 6 tons.

	To Carry 3 Tons.			To Carry 4 Tons.			To Carry 6 Tons.		
	£	s.	d.	£	s.	d.	£	s.	d.
Tire 2 in. Wide	13	0	0	...		...	...		...
,, 2¼ in. ,,	13	10	0	...		...	...		...
,, 2½ in. ,,	14	0	0	16	0	0	...		...
,, 2¾ in. ,,	14	10	0	16	10	0	...		...
,, 3 in. ,,	15	0	0	17	0	0	18	0	0
,, 3½ in. ,,	15	15	0	17	15	0	18	15	0
,, 4 in. ,,	16	10	0	18	10	0	19	10	0
,, 4½ in. ,,	17	10	0	19	10	0	20	10	0
,, 5 in. ,,	19	0	0	21	10	0	22	10	0
,, 6 in. ,,	20	10	0	23	10	0	24	10	0

AXLES FOR CART AND WAGGON WHEELS. PRICE PER PAIR.

Size of Iron.	Axles only for Iron Nave Wheels.			Common Axles and Bushes.			Patent Axles with Oil Boxes and Brass Caps.		
in.	£	s.	d.	£	s.	d.	£	s.	d.
2	1	0	0	1	5	0	2	10	0
2¼	1	5	0	1	10	0	2	15	0
2½	1	10	0	2	0	0	3	5	0
2¾	2	0	0	2	10	0	3	15	0
3	2	10	0	3	0	0	4	5	0

THE "UNIVERSAL" GAS APPARATUS.



GASWORKS SUITABLE FOR SMALL TOWNS, VILLAGES, FACTORIES, HOTELS, MANSIONS, &c.

In many small towns in Great Britain, public companies have been formed, and in all cases where the management has been good and economical they have proved sound and profitable undertakings, highly remunerative to the shareholders and beneficial to the community. There are still many villages with populations varying from 500 inhabitants and upwards where gas could be profitably introduced, and where, if works be erected with a due regard to economy, they will yield a fair return on the capital invested.

The apparatus here described has been made to suit a great variety of circumstances; it is compact in the arrangement of its several parts, *cleanly and devoid of nuisance in working*, and produces gas at a cost varying with the size of the apparatus and the price of coal, from 1*s.* 9*d.* to 4*s.* per 1,000 cubic feet, including labour, wear and tear, interest on capital, &c.

The approximate Cost of Gas may be estimated somewhat as follows:

	£ *s.* *d.*	£ *s.* *d.*
One Ton of Newcastle or other coal of equal quality will produce 9,000 cubic feet, and costs, say . . .		0 18 0
Lime for purifying		0 0 9
Labour (say 1*s.* per 1,000)		0 9 0
		1 7 9
Creditor		
By 8 cwt of coke (over and above that required for heating)	0 6 6	
By Tar, &c. &c.	0 1 0	
		0 7 6
Cost of 9,000 cubic feet, or 2/3 per 1,000 cubic feet		1 0 3

These figures will vary proportionably with the price of coal in different localities, but they will serve as a basis for calculations.

The subjoined Prices for the apparatus complete and ready for erection include the cost of packing, and delivery in London, Liverpool, or Hull, together with plans and instructions for erection and setting to work.

		£	*s.*	*d.*		
No. 1.	15-light Apparatus,	50	0	0	weight about	1¼ Tons.
,, 2.	25 ,,	60	0	0	,,	2 ,,
,, 3.	50 ,,	80	0	0	,,	3¼ ,,
,, 4.	75 ,,	105	0	0	,,	4¼ ,,
,, 5.	100 ,,	125	0	0	,,	5¼ ,,

And works of larger size in proportion.

For use in this country, the apparatus will be fixed in complete working order at the foregoing prices, including men's wages and railway fares; the cost of transit from the works being paid by the purchaser, who will also provide the necessary masonry, brickwork, &c.

The following table more fully illustrates the working of the apparatus:—

No. or size of Apparatus.	No. of Lights.	Weight of Coal required for each Charge of Retort.	The Time required to Carbonize each Charge.	Total Cubic Feet of Gas made in a day of Ten Hours.	Dimensions of each Holder, and Storage Capacity in Cubic Feet.
		lbs	Hours.	Ft.	Ft. Ft. Cubic Ft.
1	15	14	2½	210	7 × 6 = 230
2	25	28	3	360	8 × 8 = 400
3	50	56	3½	700	10 × 8 = 640
4	75	90	4	1,000	12 × 8 = 910
5	100	140	4½	1,300	14 × 10=1.500

The sizes of the apparatus are based on the calculation that each burner will consume 3½ cubic feet per hour (a light equal to 10 sperm candles) and the whole number burning for 4 hours. The quantity of gas thus required can be produced in an ordinary working day of 10 hours. If the manufacture of the gas be continued during its consumption, the whole of the burners may be supplied for a much longer period, or they can be correspondingly increased in number, and a larger holder can be supplied if required at a small additional cost.

For localities abroad, where it is inconvenient and costly to construct brick tanks, iron tanks can be supplied, and these are forwarded in plates, marked for fitting together, with the bolts, nuts, &c. required for the purpose.

The portion of the apparatus more immediately subject to wear, and requiring renewal, is the *retort*, and it is advisable to have a spare one in readiness.

OIL-GAS AND DOUBLE RETORT APPARATUS.

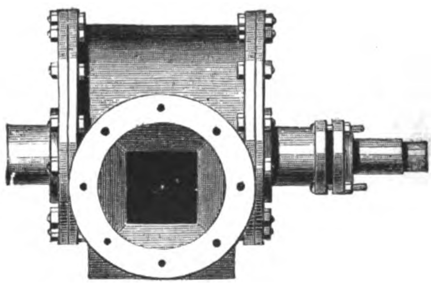
Prices, Sizes of Holders, &c.

					£	s.	d.
No. 1	for	10 burners,	Holder	6 ft. × 3 ft.	Price 27	10	0
,, 2	,,	20	,,	,, 6 ft. × 6 ft.	,, 42	0	0
,, 3	,,	30	,,	,, 7 ft. × 6 ft.	,, 55	0	0
,, 4	,,	50	,,	,, 8 ft. × 8 ft.	,, 65	0	0
,, 5	,,	75	,,	,, 10 ft. × 6 ft.	,, 75	0	0
,, 6	,,	100	,,	,, 10 ft. × 8 ft.	,, 85	0	0

Oil-gas possesses about double the illuminating power of coal-gas, but the cost is about 17/6 per 1,000 cubic feet under *good* management, and calculating that one gallon of good resin oil costs 1*s*., and produces about 80 cubic feet of gas. The price of the apparatus includes all necessary firebricks, &c. for fixing the apparatus, and also packing and delivery in London, Liverpool, or Hull.

BURTON'S PATENT ROTATORY GAS EXHAUSTERS,

With deep stuffing boxes, thick segments, and round flanged branches to suit ordinary valves, and connections.



To pass in cubic feet per hour.	H.P. required.	Price. £	s.	d.	To pass in cubic feet per hour.	H.P. required.	Price. £	s.	d.
2,000	1	22	0	0	30,000	8	95	0	0
3,000	1	26	10	0	40,000	9	126	0	0
5,000	2	31	0	0	50,000	11	160	0	0
7,000	2	36	10	0	60,000	12	Prices quoted specially.		
10,000	4	42	0	0	80,000	15			
15,000	4	53	0	0	100,000	18			
20,000	6	66	0	0	150,000	26			

BURTON'S GAS VALVES, with wedged back doors, and powerful worm and rack, with index that can be seen by day, and felt readily at night.

Diam. of Valve . .	2	3	4 to 10	12	14 to 18	20 in. and above.
Price per inch. . .	14/6	13/6	11/6	12/0	13/6	Special prices.

BISCUIT-MAKING MACHINERY.

The great demand for "ships' bread" in all the principal sea-ports has led to the establishment of large factories, which are conducted on such a scale both as regards perfection of machinery and close attention to economy, that small factories can scarcely compete with them successfully either in quality or cost of production.

There is, however, a certain demand in the colonies and abroad which may well be supplied by local factories, and an estimate of the cost of the necessary machinery may probably be useful.

A small biscuit bakery for making ships' bread or any kind of plain biscuits will require the following machines:—

One Mixing Machine for ten to twelve stones of flour.
One Brake, with rollers, 10 in. diameter × 28 in. long for rolling out the dough ready for cutting.
One Stamping and Cutting Machine, with a set of cutters.

These machines are sufficient to keep three or four ovens constantly going with ease; the cost of the whole is about £120, and the total weight about 55 cwt. and packing for shipment costs about 5 per cent.

The power required to work the machinery is about 4 Horse-Power (see prices and descriptions of steam engines, turbines, horse works, &c.) and a line of shafting, with the necessary hangers, pedestals, pulleys, &c. is usually worth about £35, but this will vary according to the building and disposition of the machines; care should however be taken to arrange the machines so that the dough passes from one to the other and on to the ovens with the smallest possible amount of manual labour.

For a larger bakery capable of turning out any quantity up to ten tons per day, and making fancy as well as plain biscuits, the machinery required will be—

One large Mixing Machine.
One Brake 36 inches wide.
One cylinder Cutting Machine, with 18 cutters for plain bread.
One small Stamping Machine for making fancy biscuits and placing them on tins ready for the ovens.

The total cost is about £240, the weight about 85 cwt. The power required and the value of shafting and appurtenances is about the same as for the smaller plant described above. A set of cutters for fancy biscuits varies from £5 to £12, according to the number required.

The foregoing information can only be taken as general, and will frequently need modification to suit existing circumstances, but the authors will send plans and estimates if they are furnished with proper details.

DIVING APPARATUS.

THE articles named below constitute a very complete set of apparatus for Divers :—

A treble-barrel atmospheric air-pump, with gun metal barrels, wrought-iron crank, fly-wheel and handles, condensing chamber, copper cooling cistern, dial indicator, 6 wrenches fitted to all the parts, and mounted in mahogany chest with protecting ends. Till in the above containing 3 plain joints for mending tube, 1 union same as on tube, 2 crank end-nuts, 4 helmet nuts, 3 sets of bucket leathers, valve springs, washers, screw driver, oil-can, &c.

Round wicker box, containing the turned copper helmet, with segment screw-joint, 2 lead weights with gun metal mountings, helmet cushion, and 100 feet of vulcanized India-rubber tube with gun metal unions on.

Mahogany chest contains : 2 waterproof, tanned, twill Diving Dresses, with vulcanized collars and cuffs, 1 pair of strong boots with lead soles, 4 pairs of yarn hose, 2 pairs of outside ditto, 4 pairs of drawers, 6 white Guernsey frocks, 1 navy duck overall, 1 jacket, 2 neckerchiefs, 2 caps, 12 wrist-rings, 2 wrist bands, 30 fathoms of signal line, 30 fathoms of ladder line, 1 can of India-rubber solution, 1 yard of prepared canvas, 1 diver's knife, 1 shot belt.

The price for the whole of the above is £160, and for packing and case about 50*s.*

LIGHTNING CONDUCTORS.

LIGHTNING CONDUCTORS, if made of iron, should be ¾ inch to 1 inch diameter, but copper having seven times the conducting power of iron, if made of copper, they will have the same power if they are one-seventh the sectional area of an iron rod. In each case the rod should be carried in glass, earthenware, gutta percha, or some other electrical non-conducting material; the upper end must be tipped with a copper ball and spikes, and the lower end must be carried away from the building, if possible through a dry trench filled round with breese or charcoal, the latter being preferable, and the end also tipped with copper taken to a well or some other thoroughly moist place.

PATENT WIRE TUBE BRUSHES,

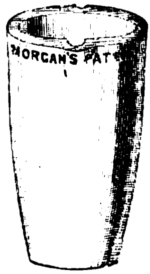
FOR CLEANING THE TUBES OF ALL KINDS OF MULTITUBULAR BOILERS.

Steel wire tube brushes, up to three inches	each	5/6
Ditto shackle end and pointed	,,	4/6
Whalebone tube brush	,,	4/0
Hair tube brush	,,	4/0
Long handles, with guard or runner seven or eight feet, with socket or shackle at end	,,	4/0
Auger for wire or whalebone	,,	4/0

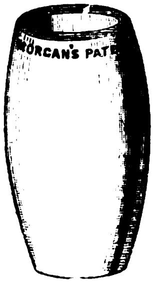
Sockets, 1/0 each. Shackles, 1/6 each. Shields, 2/0 per pair.

A

B



C



D

PATENT PLUMBAGO CRUCIBLES.

THE advantages claimed for these Crucibles by the Patentees are: that their quality is uniform; they withstand the greatest heat without danger; their average durability for *Gold, Silver, Copper*, and other ordinary metals, is forty to fifty pourings, in some cases reaching one hundred; they never crack, and heat more rapidly than any other kind; one annealing only is required; change of temperature has no effect; they can, when hot from the furnace, be dipped in cold water with safety; the saving of labour and metal is very great. (Messrs. Breeden & Booth, Birmingham, testify to the saving of 1 ton 2 qrs. 21 lbs. 4 oz. in melting 73 tons 6 cwt. of Brass.) In *Steel Melting* the saving of Fuel has been demonstrated to amount to a Ton and a half to every Ton of Steel fused. For *Zinc* they last longer than iron pots, and save the great loss which arises from mixture with iron. Those for *Malleable Cast Iron* show an average working of seven days, doing each day nearly double the work of any other Crucible.

As these Crucibles last much longer than others, it follows that the saving of metal must be great, because to each worn Crucible a quantity of metal adheres. In fact, comparing these with other Crucibles, the *saving of metal* and *fuel* alone is more than equivalent to *their cost*.

A are made in sizes varying from 2 ozs. to any required capacity, and are marked by the quantity of kilograms they will contain—thus, No. 100 will contain 100 kilograms.
B differ in shape, but correspond in all other respects with *A*, and are similarly marked.
C are marked in English pounds—thus, a Crucible marked 60 will contain 60 lbs.
D are made expressly for Steel, in various sizes.

Each Number contains 1 kilogramme, $2\frac{1}{10}$ Pounds; 3d. per Number, or

		£	s.	d.			£	s.	d.
No. 1	per doz.	0	3	0	No. 30	each	0	7	6
2	,,	0	6	0	35	,,	0	8	9
4	,,	0	12	0	40	,,	0	10	0
6	,,	0	18	0	50	,,	0	12	6
8	,,	1	4	0	60	,,	0	15	0
10	,,	1	10	0	70	,,	0	17	6
12	,,	1	16	0	80	,,	1	0	0
14	,,	2	2	0	90	,,	1	2	6
16	,,	2	8	0	100	,,	1	5	0
18	,,	2	14	0	200	,,	2	10	0
20	,,	3	0	0	300	,,	3	15	0
25	,,	3	15	0	400	,,	5	0	0

Patent Plumbago Muffles	. . . .	2*d.* per Number.
Ditto Covers	. . . .	1*d.* per ditto.
Ditto Stands	. . . .	1*d.* per ditto.
Ditto Stirrers	. . . .	12*s.* per dozen.

PATENT PIPE AND BOILER COVERING, FOR PREVENTING THE RADIATION OR TRANSMISSION OF HEAT.

The materials of which this covering is composed consist mainly of hydrocarbon, in combination with fixed carbon, and the composition thus manufactured is the best non-conducting material known. It will remain unaffected by heat up to a temperature of 500°, which is far beyond anything likely to be required of it. Being of a tough, fibrous, and porous nature, its adhesiveness will not be affected by the expansion and contraction of the pipe or boiler; and, moreover, as the hydrocarbon will volatilize only at a red heat, it will not disintegrate, but will gradually form itself into a substance resembling the bark of a tree, whilst its oily nature acts as a preservative to the iron. The composition, being light, will cover a larger area than any argillaceous compounds.

Its usefulness in covering marine boilers cannot be over-estimated. Being light, it does not add much to the weight of the boiler; and the comparative coolness in the engine room, together with the saving in fuel (from 20 to 30 per cent.) are sufficient to recommend it for general use.

It can be best applied to a boiler or pipe when under steam pressure.

AVERAGE PRICES, INCLUDING MATERIAL, MEN'S TIME, &c. FOR COVERING.

Pipes.—Outside measurement and length over all of range			1/0	per foot superficial.
Boilers.	Ditto	ditto	1/3	ditto.
„ By Cake	Ditto	ditto	1/6	ditto.

Or for the Material in casks about £7 per ton.
Casks are charged extra.
Cakes 1 foot square, dressed for use, 9/0 per dozen.
Patent Wire Netting .

DIRECTIONS FOR USE.

1st. For Boilers.—The boiler is best covered when under steam pressure. Make a wash of equal quantities of the composition and water, and lay over the parts to be covered with a lime brush. When dry, reduce more of the composition to the consistency of stiff plaster, and spread it half an inch thick. Let this *nearly* dry, then add other coats in the same way until a thickness of 1¾" to 2" be on the boiler. Finish with three coats of well boiled tar.

Boilers are also covered with solid cakes made to a radius. 2" of the loose material is placed on the boiler and allowed to dry. The cakes are then jointed and bedded by means of a light coat of the material ¼" thick. Add three coats of tar.

The outer covering is of Iron Wire Netting, tightly laced with Copper or Charcoal Iron Wire well covered with Tar, which renders it impervious to weather and almost indestructible.

Should a leak occur at any time in the boiler, the composition at that part will become soft and pulpy, thereby betraying the fact. The covering must then be removed at that particular spot until the leak is repaired.

Steam Pipes are covered in a similar manner to that described above, except that a twisted hay band, about three-quarters of an inch diameter is steeped in the solution, and coiled tight round the pipes; then rub the solution well in, and add other coats until the whole is entirely covered. When all is dry finish with tar, varnish, or paint, as before described.

One ton of the composition covers about 240 square feet of pipes, or 160 feet of boiler surface. Where the square cakes are used, one ton will cover 280 square feet of bedding for them.

BOILER INCRUSTATION.

In a series of researches on the incrustation in Boilers, Dr. Phipson has observed that most kinds of water are rendered incapable of forming deposit, if a small quantity of hydrate of soda, or carbonate of soda, is mixed with the feed water; and if used in proper proportions, there is no tendency to prime or to clog the pistons, lubricators, &c.

For ordinary river, well, and canal waters, 14 grains of caustic soda per gallon of water is found sufficient to render insoluble the whole of the lime and magnesia contained in the water.

For fresh water, which contains much sulphate of lime, about 24 grains of carbonate of soda per gallon should be used, and for sea water about 370 grains of carbonate, or 235 grains of hydrate of soda per gallon.

If the feed water contains a small amount of alkaline salts, it not only cannot form an incrustation, but it has also the important property of preventing the boiler plates from rusting.

APPARATUS FOR DISTILLING FRESH WATER FROM SALT WATER.

An ample supply of fresh and pure water on board ship is always attainable with a properly constructed apparatus, by no means costly, or difficult to work.

Several different arrangements have been proposed and tested in use, the leading principle in each being that of the common worm condenser, and consisting of a cylinder inclosing a worm or sheaf of pipes, into which steam is admitted from a boiler; a stream of cold water is supplied through a nozzle at the bottom of the cylinder, and is discharged at the top, the action of the cold water being to condense the steam in the coil of pipes; it is then drawn off at the bottom as distilled water.

The water thus produced, although pure, and suitable for manufacturing purposes, has an unpleasant odour, and is indigestible in consequence of the small amount of carbonic acid gas and oxygen it contains; this can, however, be remedied to some extent by exposure to the atmosphere and the agitation which necessarily takes place on board ship.

The price of this apparatus is:—

To condense up to	200 gallons	per 24 hours	. . . . .	£20	0	0
„ „	600	„ „	. . . . .	25	0	0
„ „	800	„ „	. . . . .	30	0	0
„ „	1200	„ „	. . . . .	32	10	0
„ „	1800	„ „	. . . . .	35	0	0

When the water is required for culinary purposes, or for drinking, as on board ship, in hospitals, lighthouses, &c. perhaps the most convenient form of condenser is that originally introduced by Dr. Normandy, which aërates and filters the water as it comes from the condenser, and renders it free from the nauseous odour alluded to above.

In Dr. Normandy's process, the oxygen and carbonic acid gas contained in the supply of cold water are separated from it by the heat of the steam, and caused to be mixed with the condensed steam; this aerated water is then passed through a refrigerator, and lastly through an animal charcoal filter, the water being drawn off cool, fresh, and wholesome.

Prices:—

To condense up to	200 gallons	per 24 hours	. . . .	£47	10	0
„ „	300	„ „	. . . .	58	0	0
„ „	400	„ „	. . . .	69	0	0
„ „	500	„ „	. . . .	80	0	0
„ „	600	„ „	. . . .	89	0	0
„ „	700	„ „	. . . .	98	0	0
„ „	800	„ „	. . . .	107	10	0
„ „	1000	„ „	. . . .	123	0	0

RONALD'S PATENT ROPE AND CORDAGE MACHINES.

BRUSHING MACHINE.

THIS Machine—although not indispensable—facilitates subsequent operations, greatly improves the colour of the fibre, and increases its value very considerably by removing all extraneous matters.

The wages paid per ton for brushing the fibre are insignificant compared with the advantages accruing from the use of this Machine.

MANILLA HECKLING-MACHINE.

The only *Self-doffing Continuous* Heckling Machine in practical use. Heckles from 30 to 40 cwt. per day, and opens the fibre completely *without in the least injuring it.*

With the aid of these Machines the cost of preparing is from 6*d.* to 9*d.* per cwt.; this includes Cutting, Putting through the Machine, and Letting down by hand, which latter operation, in consequence of the efficient manner in which the material is dressed in the Machine, consists simply in throwing the fibre through heckles in order to straighten it. The material is then spun from the waist as in hand spinning.

SPINNING MACHINE, NO. 1.

The advantages of this Machine are, that the yarn spun by it possesses the strength and smooth appearance of the best quality spun by hand (the length of fibre used being 3 to 4 ft.), combined with the regularity of that spun by machinery. It makes from 100 to 140 lbs. Manilla, or 120 to 150 lbs. green Hemp Rope-yarn of average size per day, according to the skill of the spinner, *at a cost of* 1*s. to* 1*s.* 6*d.* per 112 lbs. *for labour, requiring so little skill to operate it, that girls are competent and in a few days become expert hands.* The Machine will spin all kinds of HEMP, MANILLA, FLAX, COIR, and SIMILAR FIBRES.

SPINNING MACHINE, NO. 2.

A smaller Machine than the above, on the same principle, for spinning yarns (say up to 8's), for Twine and other purposes. By its use the manufacturer is enabled to make yarns of *excellent quality and great strength, at a small cost in wages.*

TOPPING MACHINES FOR CORD, TWINE, FISH-LINES, COTTON BANDING, &c.

The motions in these machines being positive, the tension of the strands is uniform, and consequently a perfect Cord is ensured. The size of Cord is easily changed, and the amount of twist can be regulated at will. They require very little power, and a girl can attend to several of them. *The quantity and quality of the Cord they produce, the low cost of production, and small space they occupy,* compared with the present method of "topping or laying" in the walk, render their employment most advantageous to manufacturers.

ROPE MACHINES.

The Rope-Machines form the Strands and lay the Ropes in one operation. *Simplicity of construction* removes all liability of their getting out of order, and renders them capable of

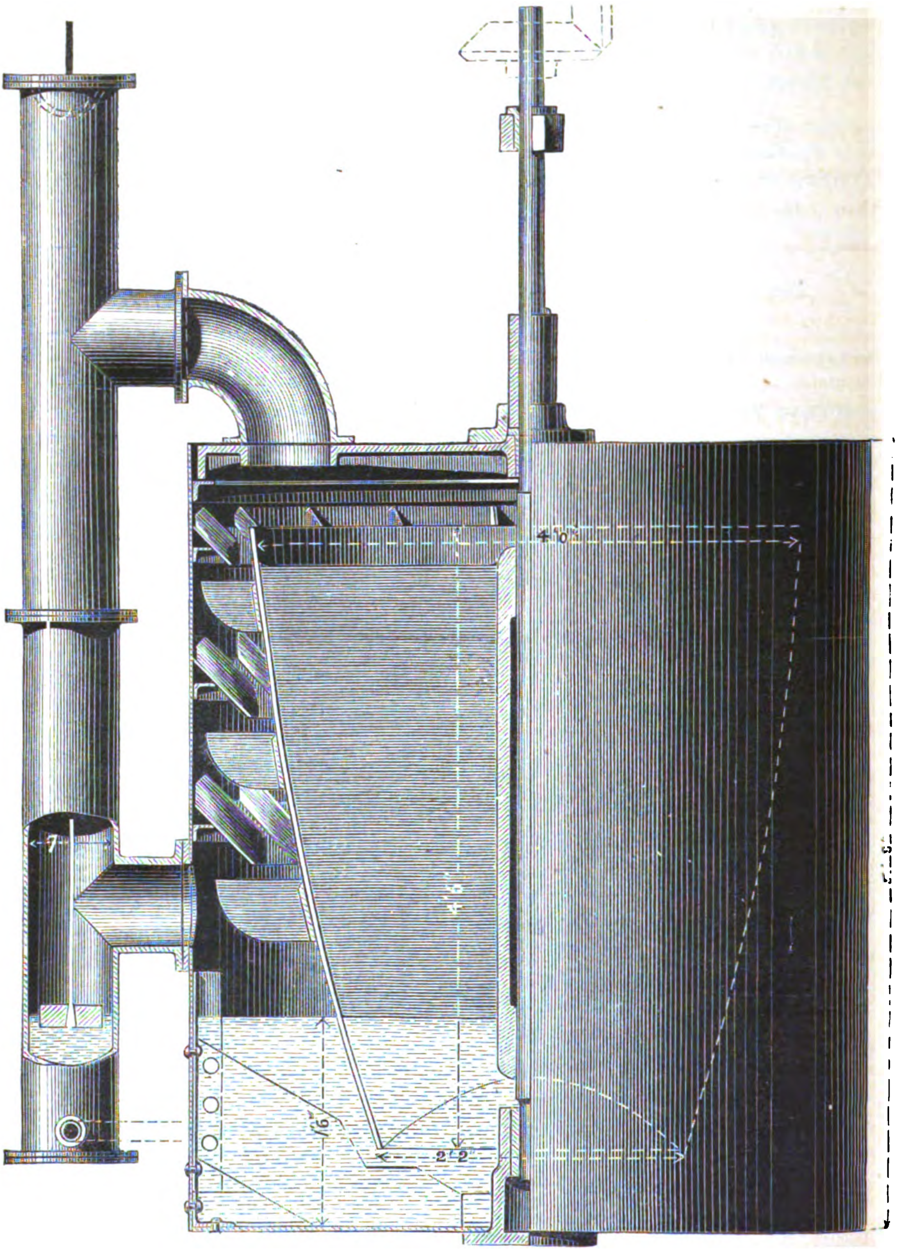
being run at a *higher rate of speed* than other machines of the same class. They require but little ttention and will "lay" equally well all kinds of material (*tarred or untarred*), whether HEMP, MANILLA, COTTON, or JUTE.

NOTE.—*The bobbins of Spinning-Machine No. 1 are arranged to fit the Rope-Machines, and those of Spinning-Machine No. 2 to fit the Cord-Machines, thus avoiding re-winding. DRUM WINDING-MACHINES are usually supplied, for winding fine yarns in the hank on to the bobbins of the Topping-Machines.*

Names of Machines.	Power Required.	Space Occupied.	Approximate Quantity produced per day.	Price, including Patent right.
No. 1.—BRUSHING MACHINE.	1 Horse.	5ft. by 11ft.	40 cwt.	£100.
2.—HECKLING MACHINE.	2 Horse.	5ft. by 11ft 6in.	35 cwt.	£160.
5.—SPINNING MACHINE, No. 1.	¼ Horse.	3ft. by 5ft. 6in.	120 lbs.	£30.
6.—SPINNING MACHINE, No. 2.	⅛ Horse.	2 ft 6 in. by 4 ft.	According to size of Yarn.	£25.
7.—TOPPING MACHINE for HEAVY CORD, TWINE, COTTON BANDING, &c, 2 Spindles.	¼ Horse.	3ft. by 7ft.	30 to 40 lbs.	£50.
8.—Ditto, 3 Spindles.	¼ Horse.	3ft. by 7ft.	40 to 50 lbs.	£65.
8A.—TOPPING MACHINE for MEDIUM and FINE CORD, 6 Heads, 3 Spindles each.	¾ Horse.	4ft. by 4ft.	60 lbs.	£80.
8B. - Ditto, 12 Heads, 3 Spindles each.	1 Horse.	8ft. by 4ft.	120 lbs.	£150.
9.—TOPPING MACHINE for VERY FINE COTTON and SILK CORD, 4 Heads, 3 Spindles each. †	½ Horse.	3ft by 6ft.	40 to 60 lbs.	£140.
10.—6 THREAD ROPE MACHINE, 2 Threads to a Strand.	½ to ¾ Horse.	3ft. 6in. by 11ft.	2,100 Fathoms.	£100.
11.—9 and 12 THREAD Ditto, 3 and 4 Threads to a Strand.	1 to 1½ Horse.	4ft. by 12ft.	1,800 Fathoms.	£130.
12.—15 and 18 THREAD Ditto, 5 and 6 Threads to a Strand.	1½ to 2 Horse.	4ft. 6in. by 13ft.	1,600 Fathoms.	£150.
13.—21 and 24 THREAD Ditto, 7 and 8 Threads to a Strand.	2 to 2½ Horse.	4ft. 6in. by 14ft.	1,500 Fathoms.	£175.
14.—60 and 84 THREAD Ditto, 20 to 28 Threads to a Strand.				£300.

† With 2 or 3 Heads £40 per Head.

All prices are nett. For Export, Cases and Packing are charged 7½ per cent. extra.



SIEMENS' POWER-ABSORBING GOVERNOR.

For Description, *see next page.*

The Engraving kindly lent by the Editor of "Engineering."

SIEMENS' POWER-ABSORBING GOVERNOR.

APPLEBY BROTHERS, SOLE MAKERS.

After describing the Governors usually employed, and the treadmill and other machinery constructed by Appleby Brothers, for profitably employing the prisoners sentenced to "hard labour," and erected at Walton Gaol for the Corporation of Liverpool, the writer of the paper* described the Siemens' Governor as follows:—

"*Governing the Speed of Machinery.*—None of the appliances shortly mentioned in the foregoing description appeared to the writer to be sufficiently reliable to govern the speed of the machinery when the power applied fluctuated between such wide limits, and as it was necessary, that whether the greater or lesser, or any intermediate number of men were employed, or even when none of the machinery is in operation, as will sometimes occur, one uniform speed should be maintained, and any surplus power should be instantly and automatically absorbed, he decided to use the Siemens' cup governor. As this beautiful invention has been described, and the theory of its action fully developed in a paper read by Mr. C. W. Siemens before the Royal Society (April, 1865), and published in their philosophical transactions, it will be unnecessary to enter into the theory of the apparatus, or to do more than describe its application for the purpose under consideration.

A cylindrical vessel, 5 ft. 8 in. high and 4 ft. 10 in. diameter, containing about 12 in. of water, forms the outer casing, and to it are fixed a number of vanes, as shown in the diagram. Inside the vessel, and dipping into the water, is a parabolical cup. Hung on a central vertical spindle, on the outside of this cup, are a number of vanes, spaced to come between the vanes on the outer casing.

A rotatory motion of about 80 revolutions per minute is imparted to the cup; and so long as the velocity of rotation does not exceed 79·2 revolutions per minute, the water in the casing will rise inside the cup to nearly the brim without overflowing, and the only retarding influence produced consists in the friction of the lower edge of the cup slipping through the water, and amounting to much less than one man's power.

So soon, however, as the speed of the cup in the smallest degree exceeds 79·2 revolutions per minute, the water will immediately overflow, which overflow will continue, inasmuch as the same water will evidently be raised continuously from the reservoir below, and returned to it after being acted upon by the series of rotating and stationary vanes already described.

The quantity of water thus mechanically acted-upon being large, the power absorbed is also very considerable, and rises with the slightest increase in the velocity of the cup to more than 30 horse power, and this power may be increased or diminished to almost any extent by simply increasing or diminishing the depth of water in the outer casing.

This governor was put to work on the 1st of May last, and has been in constant use ever since with such satisfactory results that, whether the number of men on the wheel is the minimum of 70 or the maximum of 216, there is no appreciable variation in the speed of the treadwheels.

In the official trials conducted by Mr. Fairbairn, the whole of the machinery was put to the most severe tests to which it could ever be subjected. In the first instance forty men were ordered on the wheel, working the governor only; the number was then suddenly increased to 216, still driving the governor only, without the slightest perceptible increase of speed; the whole of the machinery was then thrown on full work, in addition to the governor, and still there was no appreciable variation in the speed of the mill. A number of other tests were then made which it will be unnecessary to describe.

From the results obtained in the instances under consideration, there can be no doubt that where great regularity of speed is required and a frequently varying load, the Siemens' Governor can be most advantageously employed, and this has induced Mr. Fairbairn to adopt a governor precisely similar to that at Walton Gaol for the new gaol at Manchester."

* Paper read before the British Association at Norwich, "On Mechanism for Utilising and Regulating Convict Labour." By C. J. Appleby, of London, M.I.M.E., and Assoc. Inst. C.E. See "Engineering," August 28th and September 4th, 1868.

HOT WATER APPARATUS.

In setting out Hot Water Apparatus, the subjoined practical data will probably be found useful.

For warming churches, factories, assembly rooms, private houses, and generally such buildings as require to be heated quickly, the size of pipes usually adopted is from 2 in. to 3 in. diameter, perhaps more frequently 2 in. than any other size; but for conservatories, hot-houses, and buildings where a steady and sustained heat is required (in many instances after the fire has gone out), pipes of 4 in. diameter are preferable, and in no case is it desirable to use pipes of larger diameter, on account of the weight, cost, comparative weakness, and the length of time requisite to raise them to the proper temperature. Assuming the velocity at which the water travels to be the same in pipes of the different sizes named, the ratio of friction due to each size is as follows:—

Diameter of pipe . . .	½	1	2	3	4
Ratio of friction . . .	8	4	3	1·3	1

So that the friction in a pipe of 1 inch diameter is four times greater than in one of 4 inch diameter; and as the ratio of cooling is expressed by the same figures, it is clear that pipes of moderately large diameter are preferable to small ones. It is of the utmost importance to avoid all unnecessary dips and irregularities in the pipes, and especial care should be taken to give the pipes sufficient descent to allow the water to flow by gravitation to the bottom of the boiler, and that an air-cock should be placed at the bottom of each dip, or wherever it is probable air will collect.

With regard to the boiler, where a moderate heat is required, experience has shown that, with a well-constructed and well-set boiler, about 1½ square feet of grate surface is sufficient to give the necessary degree of heat to 300 feet of 4-inch pipe; and perhaps the best form of boiler for general use is the No. 14 boiler (see page 386); but where a high temperature of the pipes—say 140° above that of the surrounding temperature—has to be maintained, it will be a safe rule to allow not more than 50 feet of 4-inch pipe to each square foot of *true heating* surface; but if only 100° of heat is required, the same boiler will suffice for about 70 feet of pipe.

With respect to the quantity of pipe necessary to maintain a given degree of heat, the subjoined data has been long and successfully used :—

"The quantity of air to be warmed per minute in habitable rooms and public buildings must be 3½ cubic feet for each person the room contains, and 1¼ cubic feet for each square foot of glass. For conservatories, forcing-houses, and other buildings of this description, the quantity of air to be warmed per minute must be 1¼ cubic feet for each square foot of glass which the building contains. When the quantity of air required to be heated has been thus ascertained, the length of pipe which will be necessary to heat the building may be found from the following rule : Multiply 125 (the excess of temperature of the pipe above that of the surrounding air) by the difference between the temperature at which the room is purposed to be kept when at its maximum, and the temperature of the surrounding air, and divide this product by the tempera-

ture of the pipes and the proposed temperature of the room; then the quotient thus obtained, when multiplied by the number of cubic feet to be warmed per minute, and this product by 222 (the number of cubic feet raised 1° per minute by 1 ft. of 4-inch pipe), will give the number of feet in length of pipe 4 inches diameter, which will produce the desired effect." *

If 3-inch pipe is used, the product obtained by the above rule must be multiplied by 1·3, and if 2-inch pipe is used, multiply the product by 2 for the number of feet of each size of pipe required.

In climates where the external temperature is lower than in this country, a proportionate allowance must be made, all these calculations being based on the assumption that the minimum temperature of the external air will not be lower than 10° Fahrenheit.

WARMING BY STEAM.

From Dr. Arnott's observations it has been proved that one horse power of boiler capacity is sufficient to heat 50,000 cubic feet of space, and that to maintain a temperature of 60° when the thermometer is 10° below freezing point, and the ventilation allows 16 cubic feet of external air to enter the building per minute, the proportions of heating surface should be—

1 foot of 4-inch pipe for each 6 feet area of window; and 1 foot of 4-inch pipe for each 120 superficial feet of wall, ceiling, and floor.

JOINTS FOR HOT-WATER APPARATUS.

For temporary use, a ring of India rubber on the end of the pipe, forced into the socket, is a cheap and good joint, easily made, and readily taken to pieces.

For permanent joints, the cement in general use for cast-iron is as follows:—

One ounce of sal ammoniac to each cwt. of borings, and use it without allowing it to heat.

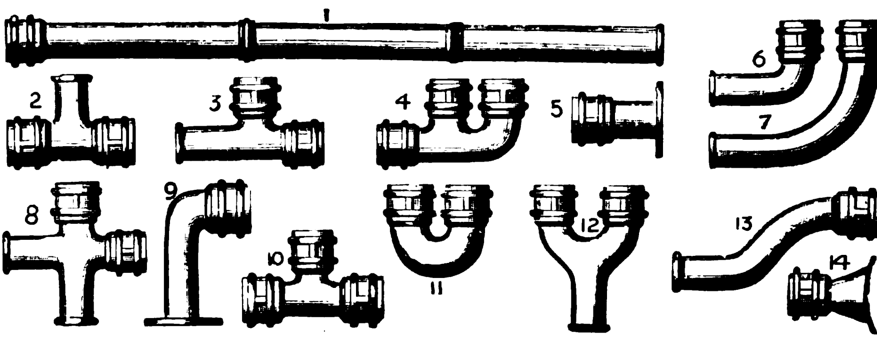
Multiply the length of any joint in feet, the breadth in inches, the thickness in eighths and by 3, the product will be the weight of dry borings in lbs. avoirdupois required to make cement to fill that joint nearly.

STEAM JOINTS FOR ENGINEERS' WORK.

Improved Anti-corrosive Cement for making joints for steam, water, gas, or for heating apparatus, which will stand any pressure of steam or water. The joints are easily made, and the cement can be applied either to uneven or face work, sets quickly, and is economical in cost.

Price 6*d*. per lb. or less if supplied in quantities of 1 cwt. and upwards. Bags or casks charged extra.

* Hood, on Warming and Ventilation.



HOT-WATER PIPES AND CONNECTIONS.

	All proved to High Pressure.			
	2	3	4	In. diam.
	s. d.	s. d.	s. d.	
1. Hot-water Socket Pipes, 6 ft. long	1 6	2 6	3 0	per yard.
Ditto, 5 ft. or 9 ft. long . .	—	2 6	3 0	,,
Ditto, 3 ft. (or under) . .	1 8	2 9	3 3	each.
Ditto, with Trough for Vapour . .	—	—	6 0	per yard.
Ditto Coil Pipes, without Sockets .	1 8	2 6	3 6	,,
6. Elbows, Common	1 11	2 10	3 8	each.
7. Ditto, Long	2 7	4 6	7 0	,,
Ditto, with Double Sockets (inside)	2 0	3 4	4 6	,,
Ditto, with ditto (outside) . . .	2 8	4 6	7 4	,,
Ditto, with ditto inside, ⅛th of a circle . . .	2 0	3 3	4 6	,,
Ditto, with ditto outside, ditto	2 8	4 6	7 0	,,
Ditto, double	3 0	4 10	7 0	,,
Ditto, diminishing. (*See* next page)				
9. Ditto, Flange and Socket, long	2 10	3 9	5 2	,,
Ditto, ditto, short	2 2	3 4	5 0	,,
Ditto, ditto, for Boiler-top . .	3 7	4 6	5 0	,,
13. Swan Necks	3 6	6 6	8 0	,,
S Pipes	3 0	6 6	8 0	,,
14. Boiler-top, with Flange and Socket, straight .	3 4	4 6	5 0	,,
11. Syphons, close or wide	2 2	4 0	7 6	,,
Ditto, 3-way	3 6	7 0	10 6	,,
Ditto, 4-way	6 0	12 6	19 0	,,
12. Ditto, with Spigot or Socket outlet	3 2	6 0	8 9	,,
Ditto, 3-way, with ditto or ditto	5 0	10 6	13 0	,,
4. Ditto, with Elbow	3 0	6 6	9 0	,,
Ditto, 3-way, with ditto	6 0	10 0	16 0	,,

HOT-WATER PIPES AND CONNECTIONS—*continued.*

	All Proved to High Pressure.			
	2	3	4	In. diam.
	s. d.	*s. d.*	*s. d.*	
2 & 3. T Pipes, with 2 Sockets	3 0	5 0	6 6	each.
Ditto, with 3 Sockets	3 3	5 9	7 6	,,
Ditto, diminishing outlets. (*See* below).				
H Pipes	6 11	10 3	13 0	,,
Branch Pipes, with 1 or 2 Sockets	4 6	6 6	9 6	,,
Y or Branch Pipes, with 2 ditto	5 4	7 0	12 0	,,
8. Cross Pipes	6 0	10 0	12 0	,,
5. Flange Sockets	2 4	3 3	4 0	,,
Ditto, Spigots	2 0	2 4	4 0	,,
Double Sockets	1 9	3 2	4 0	,,
Collars, Single	1 4	2 0	2 8	,,
Ditto, Double	2 6	3 4	4 4	,,
Ditto, Sliding	1 2	1 9	2 1	,,
Blank Sockets	10*d.*	1*s.* 6*d.*	2*s.* 0*d.*	,,
Ditto Spigots	4½*d.*	10*d.*	1*s.* 2*d.*	,,

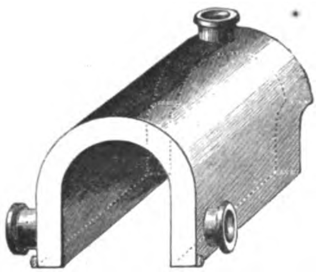
DIMINISHING CONNECTIONS	4 × 3	4 × 2	3 × 2	Inches.
Ditto Pipes	3 0	2 4	2 0	each.
Ditto Sockets	3 9	3 4	2 3	,,
Ditto Elbows	8 8	8 0	6 6	,,
Ditto T Pieces	6 6	6 6	5 2	,,
Ditto Nipples	1 9	1 4	1 4	,,
Ditto Cross Pipes	13 6	12 0	10 0	,,

Coil Elbow for 2-inch Pipe, 1/9 each.
Two-branch Coil Syphon for 2-inch Pipe, 3/4 each.
Three-branch ditto, 4/6 each.
Pipe Stands, 7*d.* each.
Pipe Supporters, 4½*d.* and 9*d.* each.

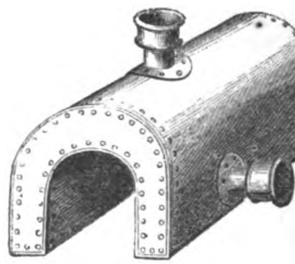
COIL BOXES.

Number of Sockets	6		7		8		9		10	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Single Coil-Box with Projecting Sockets for 2-inch Pipes, each	10	3	12	0	14	0	15	6	17	0
Ditto with Sunk Sockets for ditto	6	6	8	0	9	0	10	0	11	6
Double ditto, with ditto to order	12	0	15	0	18	0	21	0	24	0

Coils of Circulation Pipes, to order.
Iron Borings, finely sifted for Cement Joints, 10/9 per cwt.
Ditto ditto 5 cwt. and upwards, 9/0.
ORNAMENTAL GRATINGS, variety of patterns.
ORNAMENTAL COIL CASES, any size, to order.



APPLEBY'S CAST-IRON BOILER, No. 1.



WROUGHT-IRON SADDLE BOILER, No. 14.

CAST AND WROUGHT IRON BOILERS.

No. 1.—APPLEBY'S IMPROVED CAST-IRON ARCH BOILERS, with Flued Ends, and two or three sockets.

OUTSIDE DIMENSIONS.

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	. . . . No.
Inches long . . .	24	24	30	30	30	36	36	42	42	48	48	54	60	Inches long.
,, wide	15	20	17	19	22	24	23	23	24	27	30	32	32	,, wide.
,, high	15	15	16	17	18	18	21	21	22	24	27	28	28	,, high.
Heating power, about	300	400	450	550	800	900	1000	1120	1300	1800	2300	3000	4000	Feet of 4-inch pipe.
Contents of Boiler and Pipes, about . . .	162	216	243	400	432	486	520	594	689	972	1242	1620	2160	Gallons.
Price, each . . .	66s	72s.	90s.	100.	114s	120s	144s	156s	168s	222s	240s	300s	335s	Price, each.

DITTO, with IMPROVED RIBBED SIDES, for brick side flues. Price from 1/0 to 4/8 each Boiler extra.

No. 2. APPLEBY'S IMPROVED TUBULAR CHECK DRAFT, and flued ends, same dimensions as No. 1.

No. 1	2	3	4	5	6	7	8	9	10	11	12	13	
72/0	84/0	102/0	120/0	132/0	144/0	168/0	186/0	198/0	252/0	270/0	330/0	370/0	each.

No. 3. WITH IMPROVED RIBBED SIDES, for brick side flues, in other respects the same as No. 2. Price from 1/0 to 4/8 each Boiler extra.

No. 4. APPLEBY'S IMPROVED ARCH BOILERS, with tubular check draft ends, and flued sides; *all water way;* are a substitute for brick side flues. In other respects same as No. 2. Price from 10/0 to 40/0 each extra.

N.B.—The dimensions of No. 1 *Boilers refer to all the above, which may be made longer or shorter, or with an increased number of sockets.*

Boilers with Tubular Check Draft Ends possess the following advantages, viz: Increased heating surface, capacity, power and economy, and free circulation for water to flow from side to side; when only one return is required, this is most essential.

No. 5. BELL BOILERS with 2 Arms, cast in loam.

18	20	22	24	27	30	33	36	inches diameter.	each
£2 8 0	3 12 0	4 4 0	6 12 0	7 16 0	8 8 0	9 18 0	11 8 0	price . . .	

No. 6. CYLINDRICAL BOILERS with 2 Sockets.

18 × 15	20 × 17	23 × 17½	24 × 18	24 × 22	28 × 22	26 × 24	30 × 24	High. diam inches	each.
£2 2 0	2 17 0	3 12 0	4 1 0	4 7 0	5 3 0	6 6 0	6 12 0	price	

No. 7. DOUBLE CONICAL BOILERS, with Socket on Crown, and Arm on bottom.

18 × 16	21 × 18	24 × 20	26 × 24	26 × 30	27 × 34	30 × 30	in. high and dia.	each.
£3 12 0	4 4 0	5 5 0	6 6 0	7 17 0	9 3 0	9 0 0	price . . .	

No. 8. APPLEBY'S IMPROVED HORIZONTAL BATH BOILER, 18 × 6 inches, with flue side plates and bosses, bored and tapped for 1, 1¼, or 1½-inch wrought-iron tube, 15/0 each.

No. 9.—Appleby's Improved Cast-iron Flat Arched Boiler (self-flued).

21 in. long × 15 in. wide	£1 7 6
24 in. long × 18 in. wide	1 15 0

Set of 16 in. Grate Bars, with single and double bearers,

For 21 in. Boiler	£0 5 0 per set.
For 24 in. ,, ...	0 6 0 per set.

No. 10.—Independent Cylindrical Hot-water Boiler Stove, with stand, drawer, revolving feeder, flue top, and bosses for wrought-iron flow and return pipes.

18 × 15 in.	£4 0 0
20 × 17 in.	5 5 0
24 × 18 in.	7 0 0
30 × 18 in.	8 0 0

No. 11.—Improved Welded Wrought-iron Independent Cylindrical Hot-water Boiler Stove, with stand, ash drawer, smoke flue, and nozzles for flow and return pipes.

40 × 15 inches	£5 12 6
44 × 15 inches	6 12 6

No. 12.—Improved Independent Wrought-iron Saddle Boiler, enclosed in self-contained fire brick flues, with sheet-iron outer casing, nozzles for flow and return pipes, cast-iron end plates, with sliding double fire and ash doors, flue doors, damper, smoke flue, grate bars, bearer, and dead plate, complete and ready for fixing, requiring no brickwork or setting. Will heat about 600 feet of 2-in. pipe. Outside dimensions 3 ft. long × 2 ft. 4 in. wide × 2 ft. 2 in. high . £11 0 0

No. 13. Welded Wrought-iron Arch Boilers, without angle iron or rivets; water space from 1½ to 2½ inches clear; proved to a high pressure.

OUTSIDE DIMENSIONS.

No. . . .	1	2	3	4	5	6	7	8	. . No.
Inches long . .	18	24	30	36	36	42	48	48	Inches long.
,, wide . .	14	16	18	18	20	20	20	24	,, wide.
,, high . .	13	14	16	16	18	18	18	18	,, high.
To Heat about .	200	300	450	600	750	900	1000	1100	Ft. of 3-in. pipe.
Price, each .	£2 10s.	£3 10s.	£5 0s.	£6 0s.	£7 0s.	£7 15s.	£9 10s.	£10 10s.	Price, each.

Intermediate and larger sizes made to order. Sockets and fixing extra. Manhole cover and bridge 4/6 to 7/0 extra.

No. 14. Best Rivetted Wrought-iron Arch Boilers, with 2 to 3-inch clear water-space.

OUTSIDE DIMENSIONS.

No. . . .	1	2	3	4	5	6	7	8	. . No.
Inches long . .	18	24	30	36	36	42	48	48	Inches long.
,, wide . .	14	16	18	18	20	20	20	24	,, wide.
,, high . .	13	14	16	16	18	18	18	18	,, high.
To Heat about .	200	300	450	600	750	900	1000	1100	Ft. of 3-in. pipe.
Price, each .	£2 5s.	£4 15s.	£6 0s.	£7 10s.	£9 0s.	£10 0s.	£12 0s.	£18 0s.	Price, each.

Any other shape or size made to order. Sockets and fixing extra.

Double Doors and Frames, recessed; fitted with wrought-iron latch, bands, &c.

DIMENSIONS OUTSIDE THE FRAME.

	23 × 14	25 × 16	27 × 18	31 × 23 inches.
Price, each .	18/0	21/0	25/0	33/0

Sylvester's Patent Doors and Frames, for Furnaces, Hot-water Boilers, Stoves, Hot Plates, Cleaning Flues, and General Domestic Purposes, fitted with Trued Surfaces; the doors slide on inclined planes, which shut Air-tight by their own gravity, ensuring perfect control and Economy of Fuel, &c.

With Bright Bearing Bars and Friction Rollers to Upper Doors.

No. 1, Frame,	29 in. wide × 23 in. high;	Upper Door	8½ × 8½ in.;	Lower Door,	8½ × 5½ in.	£4 4s. each.
,, 2, Ditto	27 ,, × 24 ,,	ditto	10 × 8 ,,	ditto	10 × 5 ,,	£5 8s. ,,
,, 3, Ditto	26 ,, × 30 ,,	ditto	9 × 9 ,,	ditto	9 × 12 ,,	£6 0s. ,,
,, 4, Ditto	32 ,, × 32 ,,	ditto	12 × 9 ,,	ditto	12 × 9 ,,	£8 14s. ,,

Dampers and Frames. Inside Dimensions:—

	8 × 6	10 × 7	12 × 9	14 × 10 inches.
Price, each . .	1/9	3/4	4/9	6/8

Grate Bars and Bearers, to any size, at 9/0 to 11/0 per cwt.

RAIN-WATER GUTTERS AND PIPES, SMOKE PIPES, &c.

Inches	3	3½	4	4½	5	6	Inches.
HALF-ROUND GUTTERS or SPOUTS	0/7¼	0/7¾	0/8	0/10½	1/0	1/6	per yard.
Ditto Elbows and T Pieces	0/10	1/0½	1/2	1/3	1/6	1/10	each.
Ditto Nozzles	0/10	0/11½	1/0½	1/1½	1/3	1/6	,,
O. G. GUTTERS	—	0/11	0/11½	1/0½	1/3	1/11	per yard.
Elbows and Nozzles	—	0/11½	1/1½	1/4	1/7	2/1	each.
Loose Plain Clips	—	0/5½	0/5½	0/5½	0/7	0/7½	,,
Ditto Lion ditto	—	0/6½	0/6½	0/6½	0/8	0/8½	,,
O. G. GUTTERS with Plain Clips cast on	—	1/0	1/0½	1/1½	1/5	2/0	per yard.
Elbows and Nozzles	—	1/1	1/1½	1/5	1/7	2/3	each.
O. G. GUTTERS with Lion Clips cast on	—	1/1	1/1½	1/4	1/6	2/2	per yard.
Elbows and Nozzles	—	1/3	1/4	1/5	1/8	2/6	each.

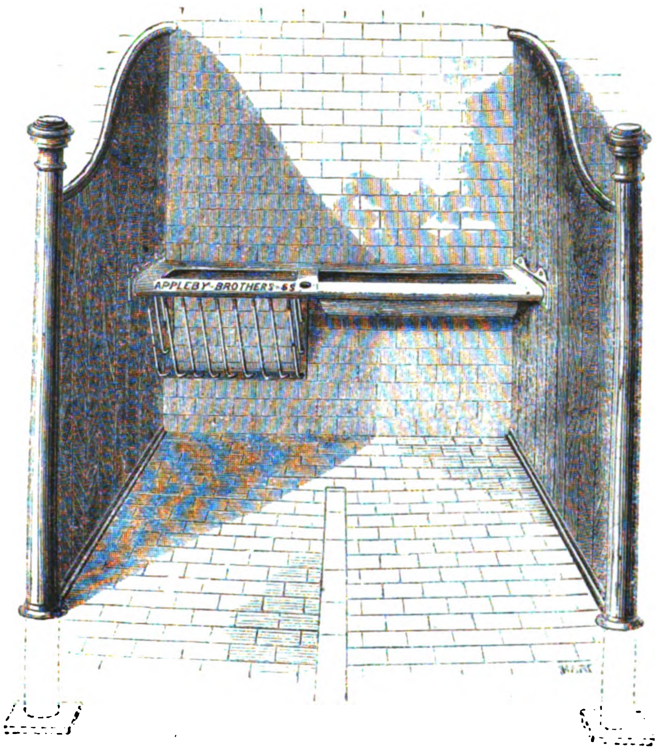
Loose Stop Ends, any size, at 3/0 per dozen. Bolts and Nuts at 5/0 per gross.
Moulded Gutters to any Section, made to order, on the shortest notice.

Inches	2	2½	3	3½	4	4½	5	6	Inches.
RAIN-WATER PIPES	0/9½	0/11½	1/1½	1/5	1/7½	2/2	2/7	3/1	per yard.
Flat and Angle Heads	1/1½	1/4	1/6	1/8	1/11	2/6	3/0	3/6	each.
Ditto, Large	1/7	1/8	1/9	2/4	2/11	4/0	4/8	6/0	,,
Shoes	0/9½	0/10½	0/11½	1/1½	1/6	1/9	2/3	2/10	,,
Boots	1/0	1/4	1/9	2/0	2/8	3/0	3/9	4/6	,,
Plinth Pipes	2/0	2/3	2/7	2/10	3/2	4/5	5/4	6/3	,,
Elbow, or Quarter Bends	1/2	1/4	1/6	1/11	2/3	2/7	3/1	3/9	,,
Swan Necks, 6-inch projection	1/3	1/4	1/7	2/2	2/6	3/1	3/8	4/8	,,
Ditto, 9-inch ditto	1/3	1/7	2/0	2/5	2/11	3/8	4/4	5/8	,,
Ditto, 12-inch ditto	1/6	2/0	2/5	3/0	3/4	4/4	5/1	6/8	,,

Pipe Nails at 8*d* per dozen.

Inches	3	3½	4	4½	5	6	Inches.
STOVE or SMOKE-PIPES	1/4	1/10	2/1	2/6	3/0	3/8	per yard.
Elbows for ditto	1/7	1/9	2/3	2/11	3/4	4/0	each.
Ditto, with Soot Doors	3/0	3/4	4/0	4/9	5/4	6/0	,,

Inches	2½ x 2½	3 x 3	4 x 4	3 x 2½	3½ x 3½	4 x 3	5 x 4	Inches.
SQUARE and FLAT PIPES	2/5	3/1	4/8	2/11	3/7	4/0	5/4	per yard.
Ditto Heads	6/0	6/9	8/0	6/9	6/9	7/4	8/9	each.
Ditto Shoes	2/8	3/0	3/4	3/0	3/0	3/4	3/9	,,
Ditto Swan-necks and Plinths to order.								



STABLE FITTINGS. PLATE No. 1.

Improved Stable-Fittings, with extra long cast manger and wrought-iron hay-rack, fitted to frame with halter rings.

To fill opening 5 feet 10 inches. Painted	per set	£2	4	3
If with iron roller front, 10/0 extra.				
Appleby's Improved Brackets for ends of top plate	per pair	0	2	6
Stall Posts plain; standing 5 feet 2 inches out of ground, and grooved for 1¼ inch boards	each	0	15	2
Ramp Rail for ditto, 9 feet 6 inch projection	,,	0	11	4
Sill Rail for ditto	,,	0	7	0

Price of the SET COMPLETE, with 2 Posts, Ramps, and Sills, £5 13 9

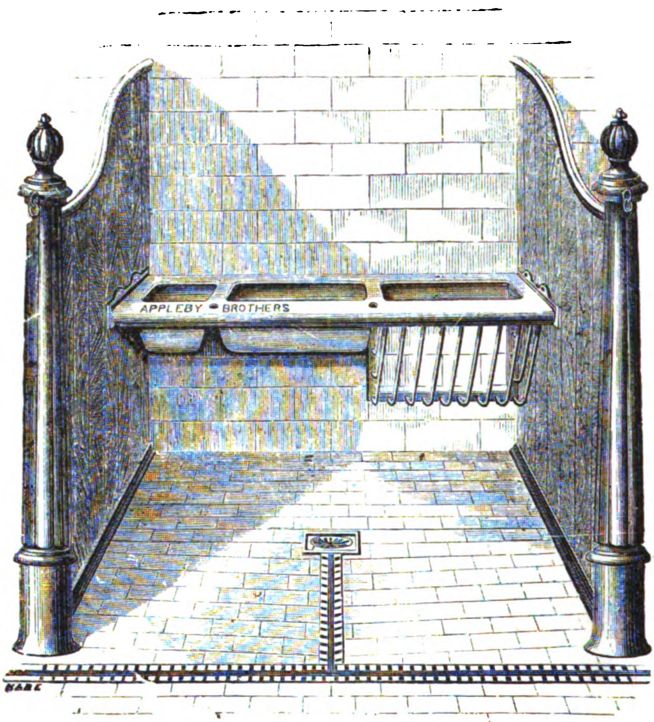


PLATE No. 2.

Improved Stable-Fittings, with cast manger and water-pan, wrought-iron hay-rack fitted to frame, with holes for halter or strap, in front edge of frame; to fill 5 feet 10½ inch opening. Painted . . . . per set £2 5 6

If with iron roller front, 10/0 extra. Valve to Water-pan 2/6 extra.

Appleby's Improved End Brackets (as No. 1)	per pair	0	2	6
Stall Post and Cap, bold, reeded pattern, with ring; standing 8 feet 6 inches high out of ground, grooved for 1¾ inch board	each	1	2	9
Ramp Rail, 9 feet 6 inches, projection to match, ditto	,,	0	9	6
Sill Rail ditto ditto		0	6	4

Price of the SET COMPLETE, with 2 posts, ramps, and sills, £6 5*s.* 2*d.*

Drain Pipe, 3½ inch diameter, roughed on the surface, in 6 feet lengths, 1/8 per foot.

In shorter lengths, 2/0 per foot.

Ditto T Pipe, 3½ inches diameter, 4/2 each.

Improved Air Traps for drains for wall or ceiling—

6	7	8	9	10	11	12 inches square.
2/6	3/9	5/1	6/4	8/3	10/9	13/4 each.

Ventilators with square frames for wall or ceiling—

8	9	10	12 inches square.
1/9	2/6	3/0	3/7 each.

Ditto all sizes up to 30 inches made to order.

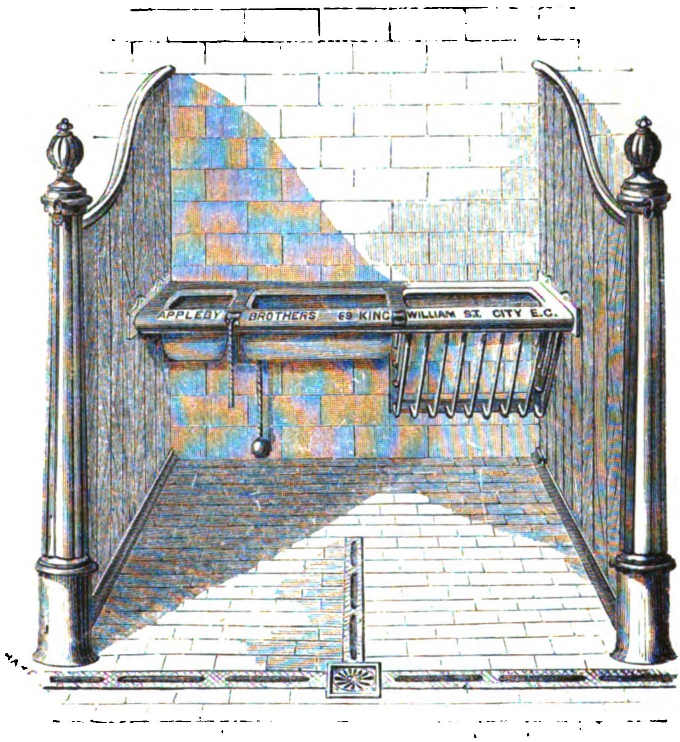


PLATE No. 8.

Improved Stable-Fittings, with extra bold moulded front; manger, water-pan, and wrought-iron rack fitted to frame, with halter rollers at front and back, the frame lipped all round inside; projection at each end to fill opening 6 ft. wide, per set £2 13 0
If with iron roller front, full width, 10/0 extra. Valve to Water-pan, 2/6 extra.
Appleby's Improved End Brackets (as No. 1) . . . . per pair 0 2 6
Post, Ramp, and Sill Rails (as No. 2) . . . . per set 1 18 7
Price of the SET COMPLETE, with 2 posts, ramps, and sills, £6 12 8.

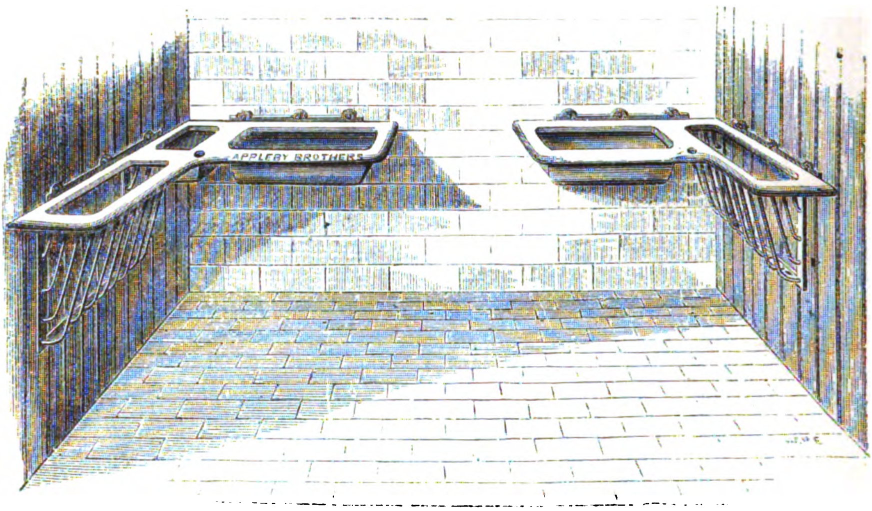
Drain Pipe, 4 × 2 inches with moveable cover, in 6 feet lengths, 2/1 per foot.
In lengths under 6 feet, @ 2/6 per foot.
Drain Grates with Frames—

8	10	12	inch square.
2/6	4/2	5/8	each.

If with Sockets, extra.

Manger, Flat, 3 feet wide, lipped ends, flap at each end, ears and rings		£0	13	4
Ditto Angle, 3 feet wide, lipped inside angles, extra large size		0	9	6
Ditto Flat, open, bold rounded front, and lipped ends for opening 5 ft. 10½ in.	each	1	5	6
Ditto with frame and rings, lipped all round for opening 5 feet 10½ inches . .	,,	2	0	0
Ditto ditto with division in centre of frame, lipped all round, for opening 5 feet 10½ inches	each	2	2	0
Enamelling extra, according to size, from 15*s.* to 30*s.*				
Hay-Rack, semicircular, 36 inches wide, for flat wall		0	7	0
Ditto angular, 33 inches across angles		0	7	0

A great Variety of Ornamental Ventilators, Stable and Granary Windows, and Skylights.



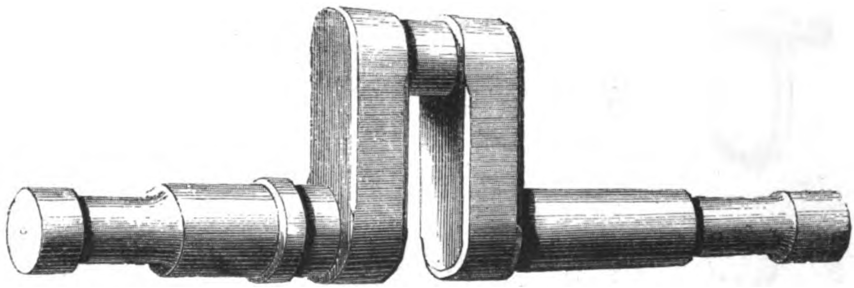
No. 5. No. 4.

IMPROVED ANGLE FITTINGS FOR LOOSE BOXES.

No. 4. Cast-iron Manger, and strong Wrought-iron Hay-Rack fitted to angle Top Plate, with bold rounded front		£2	10	0
No. 5. Cast-iron Manger, Water Pan, and strong Wrought-iron Hay-Rack, fitted to angle Top Plate, with bold rounded front		2	17	6
Wall-side Brackets, extra per pair		0	5	0
Improved Valve to Water Pan, extra		0	2	6

CAST-IRON WINDOWS AND SKYLIGHTS.

Cast-iron Skylights for Granaries, Malt Stores, &c. outside 26 × 21 inches, inside 14 × 12 inches	each	£0	14	6
Ditto ditto fitted with strong Wrought-iron Lever Handles, and Friction Rollers, outside 35 × 27 inches, inside 24 × 18 inches	each	1	0	4
Double Swing Windows 39 × 39 inches	,,	1	0	3
Ditto 39 × 45 ,,	,,	1	9	0
Ditto 29 × 54 ,,	,,	1	18	0
Stable Window with Slide Ventilator, 39 × 20 inches	,,	1	11	4
Ditto with Swing Casement and Slide Ventilator 39 × 39 inches	,,	1	5	4
Single Swing Window, 39 × 20 inches	,,	0	10	2



FORGINGS FOR ENGINEERS, SHIPBUILDERS, AND CONTRACTORS.

ALL MADE FROM BEST-SELECTED SCRAP-IRON.

SHAFTING to dimensions, under 10 cwt.		23/4
" " above 10 " under 20 cwt.		24/8
" " above 20 " under 30 "		26/8
" " above 30 " under 40 "		28/8
" " above 40 " under 50 "		31/4
" " above 50 " under 60 "		33/4
" " above 60 " subject to special quotation.		

Locomotive Axles
Piston Rods
Hydraulic Press Pillars
Marine Engine Pillars
Other Plain Forgings
} Same list as Shafting.

SINGLE CRANKED AXLES, under 3 cwt.		30/0
" " above 3 and under 10 cwt.		34/0
" " above 10 and under 20 cwt.		40/0
" " above 20 cwt. special quotation.		
DOUBLE CRANKED AXLES, under 10 cwt.		44/0
" " above 10 cwt. special quotation.		
Stationary and Marine Engine Cranks, under 10 cwt.		26/0
" " " above 10 cwt. special quotation.		

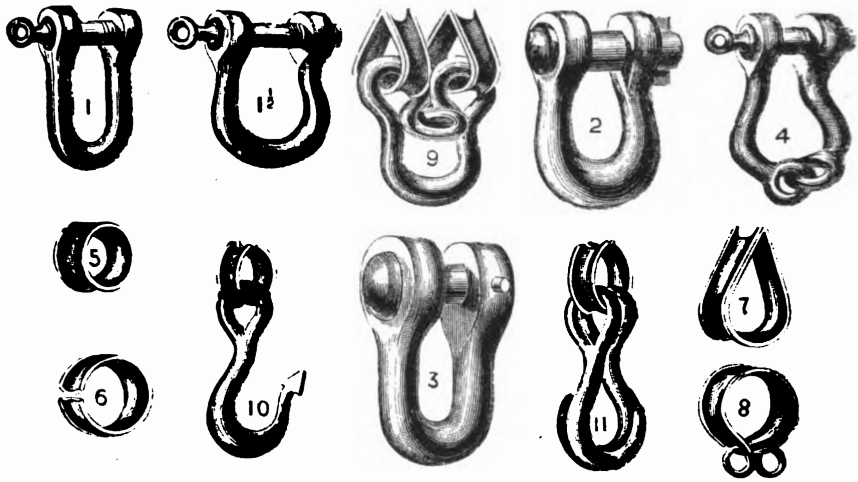
Cross Heads
Connecting Rods
Levers, &c.
} Special quotation according to Drawing.

FORGINGS for LOCOMOTIVE WHEELS.		19/4
Agricultural Forgings of every description.		
FORGED CART ARMS and PATENT AXLES		18/8
" Waggon Axles, under 1½ cwt.		17/3
" " above 1½ cwt.		20/6
" USES of every description to sketch or pattern.		
SHIP'S KNEE MOULDS, under 1½ cwt.		16/8
" " above		19/4
Ditto, smithed to moulds, and holes drilled	from	22/8
Keel Pieces, welded up in lengths 40 and 50 feet, with scarfs planed		22/8
Ditto ditto drilled		26/0

SCREW FRAMES, smithed complete, with eye bored and scarfs planed
RUDDER FRAMES, smithed and drilled complete
} According to drawing.

FORGED SQUARE BARS, under 1½ cwt.	per cwt.	16/0
" " above 1½ cwt. same as Shafting.		

FORGED BOLTS, 1/6 per cwt. more than Square Bars.



WROUGHT IRON HINGES, LADLES, CART ARMS AND AXLES, SMITH WORK AND SHIP'S IRONMONGERY.

BAILS, Flat, Light 12 in. 1/7 Middle 12 in. 2/0 Heavy 12 in. 2/8 doz.
Ditto, Round Stable 12 in. 3/7 13 in. 4/1 14 in. 4/8 doz.
Ditto, Pot No. 1. 4/1 2. 5/0 3. 6/7 4. 8/8 doz.

BEDSCREWS, all sizes, 16/0 per gross.

BRACKETS, Sash, 3 in. 1/4 4 in. 1/5 5 in. 1/7 doz.
Ditto, Shelf, ¼ & ⅜ in. 0/5¼ lb. ½ & ¾ in. 0/4¼ lb. 1 & 1¼ in. 0/3¼ lb.
Ditto, Stay, 6, 7, 8, & 9 in. 0/6¼ lb. 10, 12, & 14 in. 0/6 lb. 16, 18, & 20 in. 0/5¼ lb.

BOLTS, Monkey Tail,

	16	18	21	24	27	30	36	42	48 inches long.
	25/4	26/0	26/8	27/4	28/9	30/0	31/10	36/0	40/0 per doz.

CELLAR CANDLESTICKS, flat, 10 oz. each, 8/8 doz.

CHAIN, IRON—

Size of Iron	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	⅞	1	1⅛	in.
Weight per yard . . .	1½	2	3	4½	5¾	8	9¾	12½	14½	17½	24	31½	39	lbs.
Government Proof Strain			¾	1½	2½	3⅓	4¼	5¼	6¼	7½	10¼	13½	17	tons.
Best Short Link Cable .	80/0	54/0	41/0	33/8	29/0	25/8	24/10	23/2	21/10	20/10	20/0	19/0	18/6	₽cwt.
Stud Chain.							23/10	22/2	20/10	19/10	19/0	18/0	17/6	„
Best proved Crane Chain	85/0	59/0	46/0	38/8	34/0	30/8	30/4	28/8	27/4	26/8	25/0	24/4	23/8	„

DITTO, SHORT LINK COIL, 8 oz. 0/10¼ 12 oz. 0/6¾ 16 oz. 0/6 1½ lb. 0/5 2 lb. 0/4½ 2½ lb. 0/4¼ 3 lb. per yard. 0/4 per lb.

DITTO, COMMON COIL, 0/4½ per lb.

DITTO, UNIFORM LINK, as used for Cunningham's Patent Reefing Gear, or for working over chain pulleys. All sizes kept in stock. Prices quoted on application.

(9) CLUES Spectacle, all sizes, black . . . . 45/4 per cwt.
Ditto ditto galvanised . . . 59/0 „
CROW BARS, 3 to 3½ ft. long . . . . 35/4 „
Ditto 4 to 4½ ft. long . . . . 30/0 „
DOGS, TIMBER, all sizes . . . . 0/4 lb.
FORELOCKS, Single . . . . 0/5¼ lb.
Ditto Double . . . . 1¼ to 3 in. 0/8 lb. 3¼ to 6 in. 0/6¾ lb.
FURNITURE, SCYTHE . . . . 9/1 set.
GRIDIRONS . . . . 7 8/0 8 10/0 9 12/0 10 14/8 12 Bars 20/8 doz

Hinges, Light Cross Garnet,

No.	0	1	2	3	4	5	6	7	8	
	3/5	3/7	4/4	5/4	6/4	7/5	9/6	12/3	14/8	doz.

Ditto, Cross Garnet water joints,

No.	1	2	3	4	5	6	7	8	
	8	10	12	13	14	16	18	20	inches.
	3/7	4/4	5/4	6/4	7/8	9/9	12/8	15/4	doz.

Ditto, with Hooks, same as Cross Garnets.
Ditto, Cross Garnets weighty, or Hooks and Rides, weighty, all sizes, 26/8 per cwt.

Ditto, with Hooks on Plates,

	14	16	18	20	21 inches and above.
Light	35/4		34/0		per cwt.
Weighty			32/0		31/0 „

Ditto, Tumbler Joint Cross Garnets, 10 to 14 in. 45/4 per cwt.

Ditto, Strap, light,

No.	1	2	3	4	5	6	
	4/4	4/8	5/7	6/8	8/0	8/8	per doz.

Ditto weighty, all sizes, 30/8 per cwt.

Ditto, Quarterboard,

6	7	8	9	10	11	12	13	14	inches.
4/4	5/1	5/9	6/5	7/7	8/4	9/9	11/5	13/0	per doz.

Hammers, Chipping, for Engineers, 34/8 per cwt.

Ditto, Smiths',

all sizes to 6 lb.	7 to 10 lb.	11 lb. and above.
0/6 lb.	0/5¾ lb.	0/5¼ per lb.

(8) **Hanks**, Jib or Cringle, Black, 2½ to 3¼ in. 0/5¾ lb. 3¾ to 4 in. 0/5 per lb.
Ditto Galvanised „ 0/7 „ 0/6¼ „

Hoops, Brush, all sizes, 5/4 per gross.

Hooks, Boat,

No.	1	2	and above.
	4/8	5/1 per doz.	46/8 per cwt.

(11) Ditto, Clasp with Thimbles,

¼	5/16	⅜ & 7/16	½ & 9/16	⅝ and above.
64/8	56/0	44/8	42/0	36/8 per cwt.

(10) Ditto, Tackle and Thimbles,

No. 000 00 0 1	2 & 3	4 and above.
40/0	30/8	26/8 per cwt.

Ditto, Wall, and Holdfasts, all sizes, 0/3 per lb.
Ditto, S, all sizes, 7/4 per gross.

Hasps, with screwed starts,

4	5	6	7	8	inches.
2/6	2/8	3/4	4/0	5/0	per doz.

Irons, Caulking, Black,

Single Crease.	Double.	Spile.	Caulkings.
6/8	8/0	5/4	6/0 per doz.

Ditto, Plumbers' Soldering,

1 to 3 lb.	4 to 7 lb.
0/5¾	0/4¾ per lb.

Ditto, Rudder, Common,

No.	1	2	3	4	5	6	7	8	
	10/8	12/0	14/0	18/4	21/0	24/0	28/0	34/0	per doz.

Ditto, Rudder,

Skiffs.	Punts.
3/1 set.	2/0 set.

Ladle, eyed, weighty, and socket, all sizes, 0/6 per lb.
Ditto, Founders', 0/6¾ per lb.

Ditto, Cooks', square fronts,

No.	1	2	3	4	5	
	11/0	12/4	14/0	14/8	17/8	per doz.

Ditto, melting, light,

No.	0	1	2	3	4	5	6	7	8	9	
	4/8	5/0	5/8	6/8	7/7	8/3	9/10	11/4	13/4	15/4	per doz.

Ditto, seaming or pitch,

No.	1	2	3	
	12/4	14/0	15/4	per doz.

Marling Spikes, all sizes, 37/4 black 48/0 bright per cwt.
Mattocks and **Pick Axes**, all sizes, 42/8 per cwt.
Mauls, Carpenters', all sizes, 56/0 per cwt.
Nails, T heads to pattern, 0/4¾ per lb.
Ditto, Mop, 41/4 per cwt.
Pans, Stoking, up to 7 in. wide, 0/5¼ per lb. above, 0/4¾ per lb.
Peal Plates, all sizes, 0/4¾ per lb.
Peals, Socket, all sizes, 0/5¼ per lb.

Pipes, Funnel,

No.	1	2	3	4	5	
	4/8	5/3	5/10	6/6	7/4	per doz.

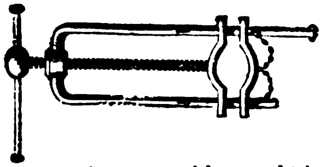
Rings, Bolt, Common—

⅜ & 7/16	½ & 9/16	⅝ & 11/16	¾ & 13/16	⅞ & 15/16	1	1⅛	1¼	1⅜ and above.
60/0	47/4	42/0	36/0	33/0	31/0	30/0	28/8	26/8 per cwt.

Ditto, Gromet,

No.	1	2	3	4	
With screwed starts	2/5	2/11	3/4	3/9	per doz.
With starts to drive	1/3	1/5	1/8	2/0	„

RINGS, Hammock, 2½ 3 3¼ 3½ inches.
12/0 13/4 14/8 17/4 per gross.
Ditto, Manger, No. 1 2 3 4
½ 1¾ 2 2½ in. inside diameter.
2/4 2/8 3/0 3/4 per doz.
Ditto, Patten, Women's, 30/8 per cwt. Cobourgs, 15/0 per gross.
Girl's, 34/8 „ Open Rings, 40/0 per cwt.
Children's, 38/8 „ Double Crinkle, 37/4 „
Ditto, Wattle, Small, 4/0 Middle, 4/8 Large, 5/1 per gross.
RAKES, Garden, 6 7 8 9 10 11 12 teeth.
7/0 8/4 9/8 11/0 12/4 13/4 14/8 per doz.



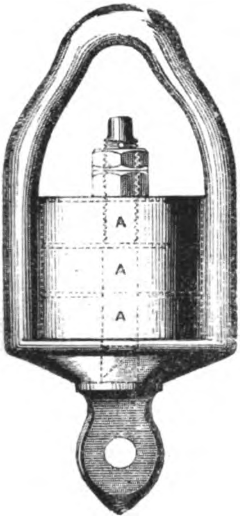
RIGGING SCREWS, wrought-iron.
10 12 14 16 18 inches.
10/6 12/ 13/ 14/ 15/6 each.

RIGGING SCREWS—with wrought-iron pillars, turned bright, square thread screw, and cast-iron clams, 10 in. 14/0 12 in. 16/0 14 in. 17/6 each.
REELS and Pins, flat, 21/4 per doz.
RUDDER IRONS—see "Irons, Rudder."
SAWS, Stone, all sizes, 0/3 per lb.
SCREW EYES, screwed, $\frac{5}{16}$ ⅜ $\frac{7}{16}$ ½ ⅝ ¾ inches.
20/0 24/0 27/4 40/0 56/0 80/0 per gross.
(2) SHACKLES, Anchor, for $\frac{9}{16}$ & ⅝ chain 59/4 $\frac{11}{16}$ & ⅞ chain 44/8 $\frac{15}{16}$ and above. 40/8 per cwt.
(3) Ditto, Coupling ¼ $\frac{5}{16}$ & $\frac{7}{16}$ ½ & ⅝ ¾ above.
0/10¾. 0/8¼ 0/6¼ 0/5¼ 0/4¾ per lb.
(4) Ditto, Jointed for sheets, all sizes, 0/7¾ per lb.
(1 & 1½) Ditto, Topsail, ¼ $\frac{5}{16}$ & ½ $\frac{9}{16}$ & $\frac{11}{16}$ ¾ and above.
0/10¾ 0/7¾ 0/6¼ 0/6 per lb.
SCRAPERS, Ship's, bright, short socket, wood handles, 13/4 per doz.
STAPLES, Rafting, ¼ $\frac{5}{16}$ ⅜ inches.
38/0 36/8 35/4 per cwt.
Ditto, Round, 1 1½ 2 2½ 3 3½ 4½ inches.
6/3 9/0 13/4 22/0 34/8 42/8 per m̄. 34/0 per cwt.
Ditto, Square, 1 & 2 2¼ & 3 3½ and above.
50/0 44/0 40/0 per cwt.
If made from ½ round iron ⅝ broad, 46/8 per cwt.
Ditto, Timber ¼ $\frac{5}{16}$ ⅜ inches.
38/0 36/8 35/4 per cwt.
SPANNERS, if less than 1 in. 1/3¼ per lb. 1 in. and above, 1/0 per lb.
SHOVELS, Paring or Plasterer's servers, No. 1 2 3 4
6/4 7/8 10/5 14/8 per doz.
STOPS, for Gates, Round and Square, 0/4¾ per lb.
SPINDLES, Grindstone, sorted, ½ to 1 in. 34/0 per cwt.
STAYS, Greenhouse, 12, 14, 16 in. 0/5 per lb.
Ditto, Casement, 3 4 5 6 7 8 9 10 12 14 16 18 in.
0/7¼ 0/8 0/9¼ 0/10¾ 1/0 1/4 1/5¼ 1/6¾ 2/0 2/8 3/4 4/0 per doz.
(6) THIMBLES, Open, No. 000 00 0 1 2 3 4 5 and above.
56/8 51/4 44/8 40/0 38/8 34/0 32/8 30/0 per cwt.
(7) Ditto, Oval, for Wire Rope, Galvanised, all sizes, 0/6¼ per lb. Black, 0/4¾ per lb.
(5) Ditto, Welded Sail, 1 1¼ 1½ 1¾ 2 2¼ 2½ 2¾ 3 3¼ inches.
Black 4/10 6/4 7/1 8/5 11/4 13/4 15/8 17/8 20/0 23/4 gross.
Galvanised 5/11 7/4 8/5 10/5 13/4 15/4 18/0 20/4 23/4 27/4 „
Ditto, Sail, weighty round and oval clue, all sizes, Black, 0/4¼ Galvanised, 0/6 per lb.
TOOLS, Smiths' to pattern, Firing Tools, 0/3¾ per lb.
Swages, Creases, &c. steel and iron, 0/7 per lb.
TONGS, Smiths', all sizes, 48/0 per cwt.
TURNS, Shutter, 5 6 7 inches.
Bent 2/0 2/3 2/5 per doz.
Straight 2/1 2/4 2/8 „
WEDGES, Splitting, sorted sizes, 28/0 per cwt.
SMITH WORK of every description made to patterns or drawings, either rough (from the forge) or finished bright and fitted up complete.

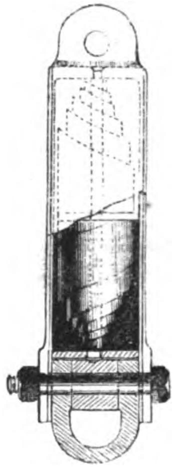
PATENT SPRINGS

FOR

WIRE ROPES OR CHAINS.



No. 1.



No. 2.

THESE springs are found to be of great advantage in COLLIERIES, and other places where wire ropes are used. By the springs yielding a little at the moment of lifting, the strain caused by a sudden jerk is taken off the rope, thus giving it a much longer duration of wear. They are equally applicable for taking the strain off CRANK CHAINS, especially where working quickly, as in the case of steam cranes, upon which they are frequently used.

No. 1 Cases are fitted with best vulcanized India rubber disc springs, specially prepared for the purpose, with iron plates between each disc, and iron case to protect it from injury.

No. 2 Cases are fitted with steel volute springs, and iron cases. Each spring is fully equal to sustain the specified weight.

To lift a load of	20	30	40	50	60	70	80	cwt.
No. 1, Cases . . .	£2 10	3 10	3 15	4 5	4 10	4 15	5 10	each.
No. 2, Ditto . . .	£5 8	6 0	6 5	7 0	7 10	*11 5	*12 0	each.

* For loads over 60 cwt. A PAIR of springs working together are better than one spring, and the prices are calculated for that arrangement.

BEST TYNE-MADE WROUGHT-IRON ANCHORS.

Size	¼—½	½—¾	¾—1	1—2	2—3	3—5	5—20	20—25	cwt.
Common Anchors .	32/0	28/9	24/6	22/0	21/6	21/0	21/0	21/0	per cwt.
Trotman's ditto .	...	...	...	32/0	29/0	27/6	26/6	27/0	"

Small Palmed Anchors 6*d.* per cwt. more than common Anchors.

Dutch Palmed ditto 1/0 per cwt. ditto ditto.

Anchors of all sizes larger than the above, for which special quotations are usually given.

STRAINING SCREWS FOR WIRE FENCING.

Diameter of Screw	¾	1 inch.
Each	18/0	19/0
Lever and Bar for ditto	1/0	1/0
Clips or Straining Pliers for ditto	5/0	5/0

STEEL AND IRON WIRE-ROPES.

Best Steel Plough Ropes. (*Round.*)

$\frac{3}{4}$ $\frac{7}{8}$ 1 — $1\frac{1}{4}$ $1\frac{3}{8}$ $1\frac{1}{2}$ — $1\frac{3}{4}$ 2 $2\frac{1}{4}$ inches in circumference.
At 85/6 — 81/6 — 75/6. per cwt.

These are made from Webster and Horsfall's *best* Patent Wire *Guaranteed*
A commoner quality of wire @ 5/0 per cwt less.

Steel Ropes (*Flat*).

$\underbrace{1\frac{7}{8} \times \frac{1}{2},\ 2 \times \frac{5}{8},\ 2\frac{3}{4} \times \frac{1}{2},}_{108/0}$ $\underbrace{2\frac{7}{8} \times \frac{9}{16},\ 3 \times \frac{5}{8},\ 3\frac{1}{4} \times \frac{5}{8}}_{95/0}$ inches. per cwt.

Iron Ropes (*Round*).

$\underbrace{1\frac{1}{2},\ 1\frac{3}{4},\ 1\frac{7}{8},}_{55/6}$ $\underbrace{2,\ 2\frac{1}{8},\ 2\frac{1}{4},\ 2\frac{3}{8},}_{51/0}$ $\underbrace{2\frac{1}{2},\ 2\frac{5}{8},\ 2\frac{3}{4},\ 2\frac{7}{8},\ 3,}_{46/0}$ $\underbrace{3\frac{1}{8},\ 3\frac{3}{8},\ 3\frac{1}{2},\ 3\frac{5}{8},\ 3\frac{3}{4},\ 4,\ 4\frac{1}{4},\ 4\frac{1}{2}}_{44/0}$ inches circum. per cwt.

Ditto (*Flat*).

$\underbrace{1\frac{7}{8} \times \frac{1}{2},\ 2 \times \frac{5}{8},\ 2\frac{3}{4} \times \frac{1}{2},\ 2\frac{7}{8} \times \frac{9}{16},}$ $\underbrace{3 \times \frac{5}{8},\ 3\frac{1}{4} \times \frac{5}{8},\ 3\frac{1}{2} \times \frac{11}{16},}_{57/6}$ $\underbrace{3\frac{3}{4} \times \frac{3}{4},\ 4 \times \frac{3}{4},\ 4\frac{1}{4} \times \frac{13}{16},\ 4\frac{1}{2} \times \frac{7}{8}}_{55/6}$ inches. per cwt.

Guides for Pit Ropes. About $2\frac{1}{2}$, $2\frac{3}{4}$, 3, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}$ inches circumference; 32/6 per cwt.
Iron Ropes if Galvanized 6/0 per cwt. extra.

Galvanized Strand Wire for Fencing, Signals, &c.

Seven Wires, No. 1, 27/0 No. 2, 23/0 No. 3, 30/0 No. 4, 18/0 per 100 yards.
Four Wires, No. 5, 15/0 No. 6, 12/0 No. 7, 10/0 per „

BEST NEWCASTLE GRINDSTONES.

WITH OR WITHOUT HOLES.

Diameter	10	12	16	18	21	24	28	32	35 inches.
Thickness . . .	2	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$	$3\frac{1}{2}$	4	$4\frac{1}{2}$	$4\frac{1}{2}$ „
Price	1/4	2/0	2/6	3/0	3/4	5/4	7/0	10/6	12/9 each.

Diameter	39	42	48	56 inches.
Thickness	5	$5\frac{1}{2}$	7	8 „
Price	16/0	22/0	40/0	54/0 each.

PATENT ASPHALTED FELT,

For roofing, or for lining damp walls, at 1*d.* per square foot, in long lengths 32 inches wide.

PATENT HAIR FELT,

For deadening sound between Partition Walls, or for clothing Steam Boilers, Cylinders, Pipes, Tanks, &c. to prevent loss of heat, or as a protection from frost. In Sheets, 34 × 20 inches.

		s.	*d.*
12 ounces	per sheet	0	6
16 „	„	0	7
24 „	„	0	9
32 „	„	0	11
40 „	„	1	1
48 „	„	1	3

BEST CAST-STEEL FILES, SAWS, AND TOOLS.

FILES AND RASPS.

FLAT, ENTERING, MILL-SAW, and 4-square 9 inches and upwards.

Inches.	1 to 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Inches.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Rough and Bastard Cut Files	4 0	4 8	5 6	6 8	8 0	9 9	11 9	13 9	16 6	19 6	23 0	28 6	34 6	41 0	48 0	55 0	63 0	per doz.
2d Cut Files and Gun Stocker's Rasps .	4 9	5 4	6 2	7 6	9 6	11 6	13 9	16 6	20 0	24 0	28 0	34 0	40 0	47 0	57 0	67 0	77 0	per doz
Smooth and Cabinet Files	5 6	6 2	7 6	9 2	10 10	12 6	14 9	17 6	21 0	26 0	30 0	36 0	44 0	54 0	64 0	74 0	85 0	per doz

EXTRAS. All above 24 inches, 12/0 per inch extra.
Flat Files, double cut on the edge, as Hand Files.
Tanged Rasps and Pin Files advance 3 inches.

HALF-ROUND, ROUND, 3-SQUARE, 4-SQUARE TO 8-INCH, HORSESHOE AND FLAT RASPS. FLAT WITH 1 ROUND EDGE, AND DOUBLE-CUT MILL-SAW FILES.

Inches.	1 to 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Inches.
	s. d.	s. d	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
Rough and Bastard Cut Files	4 2	5 0	6 0	7 0	8 6	10 6	12 6	15 0	18 6	21 6	26 0	32 0	38 0	44 0	52 0	60 0	68 0	per doz.
2d Cut and ½-Round Gun Stocker's Rasps	5 2	6 0	7 0	8 6	10 6	12 6	14 6	18 0	22 0	26 0	30 0	36 0	43 0	51 0	60 0	70 0	81 0	per doz.
Smooth Files and Cabinet Rasps . .	5 9	6 9	8 0	9 6	11 6	13 6	16 0	20 0	24 6	30 0	34 0	40 0	48 0	58 0	68 0	80 0	92 0	per doz.

EXTRAS. All above 24 inches, 13/0 per inch extra.
Horse Rasps, bevilled edges, 2/0 per dozen extra.
3-Square Rough and Middle Cut, 12-inch, 6*d*. per dozen; all above, 9*d*. per dozen extra to Bastard Cut.
Flat and High Backs, advance 1 inch.
Half-round and 3-square, cut on the edges as Hand Files.
Bellied 3-square, advance 1 inch.

HAND, PILLAR, NEEDLE ROUND-OFF, BONE FILES, POTTANCE, TOPPING, AND FLAT WITH 2 ROUND EDGES.

Inches.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Inches.
	s. d.	s. d	s. d.	s. d.	s. d	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d	s. d.	s. d.	
Rough and Bastard Cut Files . . .	4 4	5 0	6 8	8 0	9 9	11 9	13 9	16 6	19 6	23 0	28 6	34 6	41 0	48 0	55 0	63 0	72 0	per doz.
Second Cut . . .	5 0	5 9	7 6	9 6	11 6	13 9	16 6	20 0	24 0	28 0	34 0	40 0	47 0	57 0	67 0	77 0	87 0	per doz.
Smooth	5 10	6 10	9 2	10 10	12 6	14 9	17 6	21 0	26 0	30 0	36 0	44 0	54 0	64 0	74 0	85 0	96 0	per doz.

EXTRAS. All above 24 inches, 12/0 per inch extra.
Hand Files cut on both edges, also Hand Files with round edges as equalling Files.
Hand Files double cut on the edge, to advance ½-inch.
Round Off, with points, to advance 1 inch.
Topping Files, with 2 round edges, advance 1½ inch.
Needle Files, exceeding breadth of Hand Files as equallings.

EQUALLING, CANT, CROSS, SLOTTING, TUMBLER, RIFFLER, ARCH, LOCK, DOUBLE-TANGED AND BLUNT MILL-SAW FILES, PARALLEL AND COTTER.

Inches.	3½	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Inches.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s, d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	
Rough and Bastard. .	5 0	5 6	6 8	8 0	9 9	11 9	13 9	16 6	19 6	23 0	28 6	34 6	41 0	48 0	55 0	63 0	72 0	83 0	per doz.
Second Cut	5 9	6 2	7 6	9 6	11 6	13 9	16 6	20 0	24 0	28 0	34 0	40 0	47 0	57 0	67 0	77 0	87 0	98 0	per doz
Smooth .	6 10	7 6	9 2	10 10	12 6	14 9	17 6	21 0	26 0	30 0	36 0	44 0	54 0	64 0	74 0	85 0	96 0	107 0	per doz.

EXTRAS. All above 22 inches, 12/0 per inch extra.
Equalling, double cut on the edges, to be charged ½ inch extra.
Ditto with round edges, to be charged ½ inch extra.
If double cut, 1 inch extra.
Equalling and Cotter Files, extra thin, to advance 1 inch.

BEST REFINED CAST-STEEL SAW-FILES.

	1 to 3½	4	4½	5	5½	6	6½	7	7½	8	8½	9 inches	
3-SQUARE, TAPER 2D-CUT, SINGLE	3/4	3/9	4/3	4/9	5/4	6/6	7/9	8/6	9/6	10/6	11/6	12/6	per dozen.
2nd-cut Frame Saw Single-cut, and Gulletting . .	4/0	4/4	4/10	5/6	6/6	7/6	8/6	9/6	10/9	12/0	13/3	14/6	,,
3 Square Blunt 2nd-cut, and Taper Saw Files cut to Point	4/3	4/9	5/4	6/6	7/9	8/6	9/6	10/6	11/6	12/6	14/6	16/6	,,

EXTRAS. Taper Saw Files, double-cut to 4 inches, 6*d.* ;—4½ to 6 inches, 9*d.* per dozen extra.
All above 6 inches, 1/0 per dozen extra to single-cut prices.
Smooth Saw Files as Smooth Flat.
Frames, double-cut to 4 inches, 8*d.*;—4½ to 6 inches, 1/0. All above, 1/3 per dozen extra to single-cut.

	14 in.	15 in.	16 in.	18 inches.
Last-maker's Rasps	35/0	41/0	52/0	70/0 per dozen.
Saddle-tree Rasps	40/0	48/0	62/0	80/0 ditto

Rubbers, Rough and Bastard	1/3	per lb.
Ditto, Second-cut	1/5	ditto
Ditto, Smooth	1/7	ditto
Strong Flat Files, and half-thicks, Rough and Bastard	1/5	ditto
Ditto ditto ditto Second-cut. . . .	1/7	ditto
Ditto ditto ditto Smooth	1/9	ditto

Ditto, half-round and three square, 1*d.* per lb. extra to Flat Files.
Shoe Rasps, half-round ends, advance 1 inch on half-round price.
Fine Bastard and Round Rasps, as Second-cut Files.
Bread Rasps, handled, to 6 inch, 23/0 per dozen.
Ditto ditto above 6 inch, 27/0 ditto
Horse-mouth Rasps, 3/6 each.
Knife Files, to advance 3 inches on half-round price.
Feather Edges to advance 4 inches ditto
Frame Equalling Saw Files, 3 inch on half-round price.
Single Improved Shoe Rasps, ½ inch on ditto.
Double ditto 1 inch on ditto.
Round, Half-round, Three-square, and Square Files, if parallel to advance 2 inches on their respective descriptions.
All Dead Smooth Files, double the price of Smooth.
All ½-inches the price of the next size above.
Round, Half-round, and Cross Files, Double-cut Second-cut to advance ½ an inch.
Ditto, Double-cut Smooth, to advance 1 inch.

SAWS.

PIT AND FRAME SAWS.

	5 ft.	5½ ft.	6 ft.	6½ ft.	7 ft.	7½ ft.	8 ft.	8½ ft.	9 ft.	9½ ft.	10 feet.	
Cast Steel, warranted,	20/0	22/0	27/0	29/0	32/0	38/0	42/0	48/0	58/0	66/0	76/0	each.
Cast Steel,	19/0	21/0	25/0	27/0	30/0	35/0	39/0	45/0	54/0	62/0	72/0	,,
German Steel	18/0	20/0	23/0	25/0	28/0	32/0	36/0	42/0	50/0	58/0	68/0	,,

Pit or Frame Saws exceeding 11 inch heel, to advance 1/6 per inch extra nett.

CROSS-CUT SAWS.

	4 ft.	4½ ft.	5 ft.	5½ ft.	6 ft.	6½ ft.	7 ft.	7½ ft.	8 ft.	8½ ft.	9 ft.	9½ ft.	10 feet.	
Cast Steel, warranted,	14/0	16/0	19/0	20/0	24/0	26/0	28/0	34/0	42/0	48/0	58/0	66/0	76/0	each.
Cast Steel	13/0	15/0	18/0	19/0	22/0	24/0	26/0	31/0	39/0	45/0	54/0	62/0	72/0	,,
German Steel	12/0	14/0	17/0	18/0	20/0	22/0	24/0	28/0	36/0	42/0	50/0	58/0	68/0	,,

CAST-STEEL STONE-SAWS.

	5 ft.	5½ ft.	6 ft.	6½ ft.	7 ft.	7½ ft.	8 feet.	
Not exceeding 9 inches wide,	26/0	27/0	30/0	34/0	37/0	42/0	47/0	each.

If exceeding 9 inches wide, to be charged, 5½ feet—2/0; and above 5½ feet, 3/0 per inch extra, gross.

MILL-SAWS.

	5 ft.	5½ ft.	6 ft.	6½ ft.	7 ft.	7½ ft.	8 feet.	
Cast Steel,	26/0	28/0	32/0	36/0	40/0	46/0	52/0	each.
German Steel,	22/0	24/0	26/0	29/0	33/0	38/0	44/0	,,

Mill Saws stronger than the eighth gauge, to be charged to 5½ feet, 2/0 ; all above 5½ feet, 3/0 per gauge extra, gross.

Cast-steel Mill Saws, hardened and tempered; and stronger than the tenth gauge, to be charged to 5½ feet, 2/0 ; and above 5½ feet. 3/0 per gauge extra, gross.

IMPROVED PATENT TURNED CAST-STEEL CIRCULAR SAWS, Warranted True.

	4 in.	6 in.	8 in.	10 in.	12 in.	14 in.	16 in.	18 in.	20 in.	22 in.	24 in.	26 in.	28 in.	30 in.	32 inches.
	4/6	6/6	9/6	13/0	16/0	20/0	24/0	28/0	34/0	40/0	48/0	60/0	72/0	82/0	96/0 each.
Strength,					17	17T	16	15	14	14T	13	13	12	12	12 gauge.

	34 in.	36 in.	38 in.	40 in.	42 in.	44 in.	46 in.	48 in.	50 in.	52 in.	54 in.	56 in.	58 in.	60 inches
	106/0	120/0	145/0	160/0	180/0	215/0	240/0	270/0	380/0	420/0	480/0	570/0	620/0	680/0 each
Strength,	12T	11	11	11T	10E	10	9E	9	8E	8	7	6	5E	5 guage.

Circular Saws stronger than the gauge named, the price advances proportionably.

HAND, PANEL, AND RIPPING SAWS.

	10 in.	12 in.	14 in.	16 in.	18 in.	20 in.	22 in.	24 in.	26 in.	28 in.	30 inches.	
Warranted LONDON SPRING Steel.			48/0	58/0	62/0	70/0	76/0	94/0	100/0	110/0	126/0	per doz.
Cast Steel	31/0	35/0	37/0	48/0	52/0	60/0	66/0	82/0	85/0	95/0	105/0	,,
German Steel.	28/0	32/0	34/0	43/0	47/0	55/0	58/0	73/0	76/0	85/0	95/0	,,

Mahogany Handles, 4/0 per dozen extra nett. French-polished Handles, 4/0 per dozen extra nett. Polished Plates—to 26 inches, 30/0 ; to 28 inches, 34/0 ; to 30 inches, 40/0 per dozen extra nett. Fine-toothed Saws, 10 to 12 points, 2/0 ; above 12 points, 3/0 extra gross.

IRON AND BRASS BACK SAWS.

	10 in.	12 in.	14 in.	16 in.	18 in.	20 in.	22 in.	24 inches.	
Warranted Spring Brass Backs,	84/0	96/0	115/0	132/0	145/0	160/0	180/0	200/0	per doz.
Cast-steel Brass Backs	72/0	84/0	96/0	114/0	125/0	140/0	160/0	175/0	,,
Warranted Spring Iron Backs,	74/0	80/0	93/0	104/0	114/0	120/0	134/0	145/0	,,
Cast-steel, blued or bright Backs,	62/0	68/0	74/0	88/0	94/0	100/0	114/0	120/0	,,
German Steel,	56/0	62/0	68/0	80/0	86/0	92/0	106/0	112/0	,,

German Steel Blue-backed Saws, 1/0 per dozen extra nett.
Mahogany Handles, to 12 inches, 2/6 ; and above 12 inches, 3/6 per dozen extra nett.
French-polished Handles, to 12 inches, 3/0 ; and above 12 inches, 4/0 per dozen extra nett.

CAST-STEEL COMPASS OR LOCK SAWS.

10	12	14	16	18	20	inches.
20/0	21/0	22/0	24/0	26/0	28/0	per dozen.

If set and sharpened to 14 inches, 2/6; above 14 inches, 3/0 per dozen extra nett.

IMPROVED CAST-STEEL WEBS FOR CUTTING IRON OR BRASS.

8	9	10	11	12	13	14	15	inches.
11/0	12/0	13/0	14/0	15/0	16/0	17/0	18/0	per dozen.

CAST-STEEL MILL-SAW WEBS, FOR CUTTING DEAL PLANKS AND TIMBER.

15 Gauge.				14 Gauge.				13 Gauge.			
Width,	3½	4	4½ ft.	width,	5	5½	6 ft.	width,	6½	7	feet.
4 inches,	9/6	11/0	12/0	6 inches,	18/6	20/6	22/0	7 inches,	26/6	28/6	each.
4½ ,,	10/0	11/6	12/6	6½ ,,	19/6	21/6	23/0	7½ ,,	28/0	29/6	,,
5 ,,	10/6	12/0	13/0	7 ,,	20/6	22/0	24/0	8 ,,	29/6	31/0	,,

If wider or stronger than the dimensions named, the price advances proportionably.

All Saws of less dimensions than those in this list to be charged same price as the smallest size named.

AUGERS, BRUZZES, TAP AND BUNG BORERS, GIMLETS, &c.

	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1⅛ in.	1¼ in.	1⅜ in.	1½ in.	1 in.	1¾ in.	1 in.	2 in.	2¼ in.	2½ inches.
Carpenter's Shell Augers,	7/0	7/6	8/9	10/6	12/3	14/0	15/9	17/6	19/3	22/0		28/6		34/0	45/0	62/0
Ship Carpenter's Augers,	8/3	8/9	10/0	12/0	13/0	15/9	17/6	19/6	21/3	23/3		28/9		34/9		
Carpenter's Eyed Augers, with 12-inch shank,	10/6	10/6	12/6	14/6	17/0	20/0	23/0	26/0	29/0	32/0		36/0		40/0		
Black Screw Augers,	10/3	10/3	12/3	14/3	16/6	18/9	21/0	23/3	25/6	27/9		32/3		39/3		
Bright Screw Augers,	13/6	13/6	15/3	17/6	19/9	22/0	25/0	27/0	30/0	32/0		39/0		48/0		
Bright Scotch Screw Eyed Augers,	20/0	21/0	24/0	27/0	30/0	33/0	37/6	43/6	46/6	50/6		60/6		70/6		
Best Bright Brace Screw Bits,	18/0	18/0	22/0	24/0												
Taper Augers,	10/0	11/0	12/6	15/0	16/6	18/6	22/0	25/0	29/0	33/0		43/0		48/0	54/0	64/0

EDGE TOOLS OF EVERY DESCRIPTION.

SIZES OF DRAWING PAPERS.

Demy	20	×	15	Inches.
Medium	22½	×	17	,,
Royal	24	×	19¼	,,
Super-royal	27	×	19½	,,
Imperial	30	×	22	,,
Elephant	28⅜	×	23⅜	,,
Colombier	34	×	23	,,
Atlas	33¼	×	26¼	,,
Double Elephant	40	×	27	,,
Wove Antique	52	×	27	,,
Antiquarian	53	×	31	,,
Extra ditto	56	×	38	,,
Emperor	66	×	47	,,

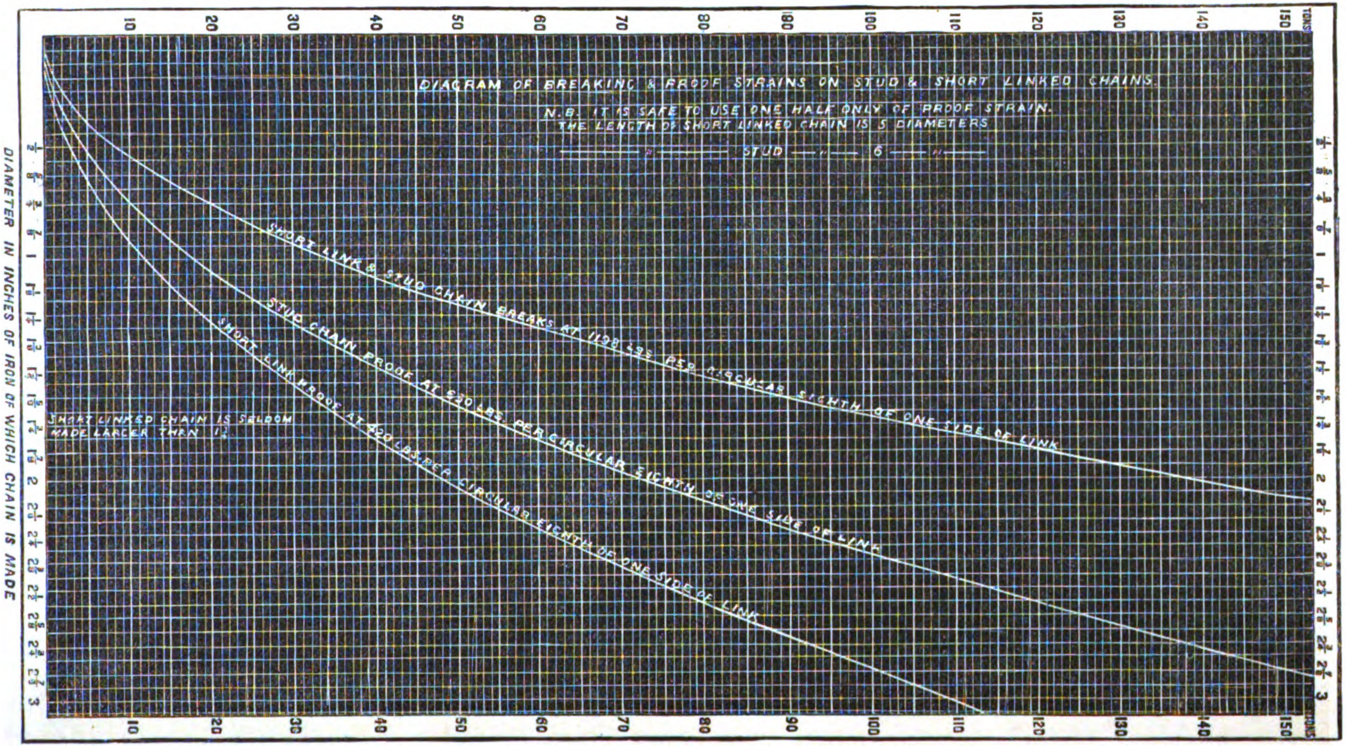
TABLES

AND

MEMORANDA.

DIAGRAM SHOWING THE PROOF AND BREAKING STRAIN OF CHAINS OF ANY DIAMETER.

BY MR. WILLIAM JACKSON.



THE proof and breaking strain is found at the points where the parabolic curves bisect the line from the left hand column opposite to the dimension of chain.

EXAMPLE: 1 inch short link chain, the proof strain is 12 tons, and the breaking strain 34½ tons.

COMPARATIVE WEIGHT AND STRENGTH OF ROPES AND CHAIN CABLES, LENGTH OF CABLES, AND WEIGHT OF ANCHORS FOR VESSELS.

BROWN, LENNOX & CO.'S Table, showing the Tonnage of Vessels, with the appropriation of their Chain Cables, and Average Weight per Fathom, and suitable Weight of Anchor.

Anchors and Cables for Steamers are not required to exceed in Weight and Length those of a Sailing Vessel of two-thirds their total Tonnage.

Tonnage of Ship.	Diameter of Cable.	Length of Cable.	Average Weight per Fathom.	Proof Strain of Stud Chain Cable.	Total Weight of Anchor suitable.	Approximate Equivalent Circumference of Rope.
Tons.	Inches.	Fathoms.	Lbs.	Tons.	Cwt.	Inches.
25	½	120	14	4½	2	4¾
35	9/16	120	17	5½	2¼	5½
45	⅝	120	21	7	2¾	6¼
50	11/16	120	25	8½	3	7
75	¾	120	30	10⅛	3½	7¾
100	13/16	150	35		5	8½
125	⅞	180	41	13¾	6½	9¼
150	15/16	180	48		7½	10
175	1	180	54	18	9	10¾
200	1 1/16	180	61		10½	11¼
250	1⅛	210	68	22¾	12½	12
300	1 3/16	210	76		15	12¾
350	1¼	240	84	28⅛	17	13½
400	1 5/16	240	93		19	14¼
450	1⅜	270	102	34	21	15
500	1 7/16	270	110		23	15½
600	1½	270	122	40½	26	16
700	1 9/16	300	132		80	
800	1⅝	300	143	47½	32	17½
900	1 11/16	300	154		35	
1000	1¾	300	166	55⅛	38	18½
1200	1 13/16	300	178		40	
1400	1⅞	300	191	63¼	43	
1600	1 15/16	300	201		46	
1800	2	300	217	72	48	
2000	2 1/16	300	230		50	
2500	2⅛	330	244	81¼	53	
3000	2¼	360	268	91⅛	57	

TABLES OF THE DIAMETER AND CIRCUMFERENCE OF ANGLE IRON HOOPS—WITH ANGLES INSIDE AND OUTSIDE.

FROM 6 INCHES TO 6 FEET DIAMETER.

Diameter.	Angle, Outward Circumference	Angle, Inward Circumference.	Diameter.	Angle, Outward Circumference.	Angle, Inward Circumference.	Diameter.	Angle, Outward Circumference.	Angle, Inward Circumference.
ft in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
0 6	1 5½	1 8¼	1 9	5 1⅜	5 11⅞	3 0	8 9¼	10 3¼
0 7	1 8⅝	1 11⅜	1 10	5 4⅝	6 3¼	3 3	9 6¼	11 1½
0 8	1 11⅛	2 3⅜	1 11	5 7¾	6 6⅛	3 6	10 3	11 11¼
0 9	2 2¾	2 6¼	2 0	5 10¼	6 10⅛	3 9	10 11⅞	12 10
0 10	2 5¼	2 10¼	2 1	6 1⅛	7 1⅝	4 0	11 8⅝	13 8⅜
0 11	2 8⅜	3 1⅝	2 2	6 4¼	7 5	4 3	12 5⅛	14 6⅝
1 0	2 11⅓	3 5	2 3	6 7⅜	7 8⅜	4 6	13 2¼	15 4⅞
1 1	3 2	3 8¼	2 4	6 10	7 11½	4 9	13 11	16 3⅛
1 2	3 5	3 11⅛	2 5	7 1	8 3¼	5 0	14 7⅞	17 1½
1 3	3 7⅞	4 3⅜	2 6	7 3⅞	8 6¼	5 3	15 4⅝	17 11⅜
1 4	3 10¾	4 6½	2 7	7 6⅞	8 10⅓	5 6	16 1⅝	18 10
1 5	4 1¾	4 10⅛	2 8	7 9¾	9 1½	5 9	16 10¼	19 8½
1 6	4 4⅝	5 1⅜	2 9	8 0⅝	9 5	6 0	17 7	20 6½
1 7	4 7⅝	5 5	2 10	8 3⅝	9 8⅝			
1 8	4 10⅝	5 8½	2 11	8 6½	9 11⅞			

NOTE.—In the Table of Angle *Outwards*, the breadth or thickness of the Angle Iron must be *added* to the circumference; thus—suppose you require to form a ring of 2-inch Angle Iron, 1 ft. 6 in. inside diameter—add 2 in. to the diameter = 1 ft. 8 in., and you will find the circumference or length of Iron to be 4 ft. 10⅝ in.

In the Table of Angle *Inwards*, the above rule is *reversed*, and the breadth or thickness of Iron must be *subtracted* from the outside diameter; thus—required a ring of 3-inch Angle Iron 2 ft. outside diameter, subtract 3 in. from the diameter = 1 ft. 9 in., and you will find the circumference or length of Iron to be 5 ft. 11⅞ in.

TAPER ANGLE IRON, OF EQUAL SIDES.

Length of Sides in Inches.	Thickness of Edges.	Thickness of Root.	Weight of One Lineal Foot in lbs. and Decimal Parts.
Inches.	Inches.	Inches.	
4	½	⅝	14·0
3	½	⅝	10·375
2¾	7-16ths	9-16ths	8·25
2½	⅜	½	6·5
2¼	5-16ths full	7-16ths	5·0
2	¼ full	5-16ths full	3·875
1¾	¼	5-16ths	3·25
1½	¼ bare	5-16ths bare	2·625

PARALLEL ANGLE IRON OF EQUAL SIDES.

Length of Sides in Inches.	Uniform Thickness Throughout.	Weight of One Lineal Foot in lbs. and Decimal Parts.
Inches.	Inches.	
3	⅜	8·0
2¾	⅜	7·0
2½	⅜	5·75
2¼	5 16ths	4·5
2	¼ full	3·75
1¾	¼	3·0
1½	¼	2·5
1⅜	No. 6 Wire-gauge.	1·75
1¼	8	1·5
1⅛	9	1·25
1	10	1·0
⅞	10	·875
¾	11	·625
⅝	11	·563
½	12	·5

TAPER T IRON.

Width of Top Table in Inches.	Total Depth in Inches.	Thickness of Top Table at Root.	Thickness of Top Tables at Edges.	Uniform Thickness of Rib.	Weight of One Lineal Foot in lbs. and Decimal Parts.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3	3½	½	⅜	7-16ths	8·0
3	2⅝	7-16ths	⅜	½	8·0
2	3	7-16ths	5-16ths	5-16ths	5·25
2½	2½	⅜	¼	¼ full	6·5
2	1¾	¼ full	5-16ths	¼	3·5
2	1½	5-16ths	¼	¼	2·875

PARALLEL T IRON, OF EQUAL DEPTH AND WIDTH.

Width of Top Table and Total Depth.	Uniform Thickness Throughout.	Weight of One Lineal Foot in lbs. and Decimal Parts
Inches.	Inches.	
6	½	
5	7-16ths	13·75
4	⅜	9·75
3½	⅜	8·5
3	⅜	7·5
2½	5-16ths	4·625
2¼	5-16ths	4·5
2	5-16ths	3·75
1¾	¼	3·0
1½	¼	2·25
1¼	¼	1·75
1	3-16ths	1·0
⅞	⅛	·725
¾	⅛	·625

MALLEABLE BAR IRON.—Weight of a Lineal Foot.

Size . . . . inches	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4
SQUARE Rolled Bars . lbs.	·208	·325	·468	·638	·833	1·05	1·30	1·57	1·87
ROUND do. ,,	·163	·255	·368	·501	·654	·82	02	1·23	1·47
Size . . . . inches	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16
Square Rolled Bars . lbs.	2·20	2·55	2 92	3·33	3·76	4·21	4·70	5·20	5·74
Round do. ,,	1·72	2·0	2·30	2·61	2·95	3·31	3·69	4·39	4·51
Size . . . . inches	1 3/8	1 7/16	1 1/2	1 9/16	1 5/8	1 11/16	1 3/4	1 13/16	1 7/8
Square Rolled Bars . lbs.	6·30	6·88	7·50	8·15	8·80	9·50	10·20	10·69	11·71
Round do. ,,	4·95	5·40	5·89	6·40	6·91	7·46	8·01	8·60	9·20
Size . . . . inches	1 15/16	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8
Square Rolled Bars . lbs.	12·52	13 33	15·05	16·87	18·80	20·80	22·96	25·20	27·55
Round do. ,,	9·83	10·47	11·82	13·25	14·76	16·30	18·03	19·79	21·63
Size . . . . inches	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4
Square Rolled Bars . lbs.	30·	32·55	35·20	37·96	40·80	43·80	46·87	50·05	53·33
Round do. ,,	23·56	25·56	27·65	29·82	32·07	34·40	36·81	39·31	41·88
Size . . . . inches	4 1/8	4 1/4	4 3/8	4 1/2	4 5/8	4 3/4	4 7/8	5	5 1/4
Square Rolled Bars . lbs.	56·71	60·20	63·80	67·50	71·30	75·20	79·21	83·33	93·2
Round do. ,,	44·54	47·28	50·11	53·01	56·	59·06	62·21	65·45	73·2
Size . . . . inches	5 1/2	5 3/4	6	6 1/4	6 1/2	6 3/4	7	7 1/4	7 1/2
Square Rolled Bars . lbs.	102 2	111·8	121·7	132·0	142·8	154·0	165·6	177·7	190·1
Round do. ,,	80.3	87·8	95·6	103·7	112·2	121·0	130·0	139·5	149·3
Size . . . . inches	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12
Square Rolled Bars . lbs.	216·3	244 2	273·5	305·1	337·9	372·7	409 0	447·0	486·7
Round do. ,,	169 9	191·8	215·0	239·6	266·3	292·7	321·2	351·1	382·2

FLAT ROLLED IRON.—Weight of a Lineal Foot.

Width of Iron.	1/4 in. Thick.	5/16 in. Thick.	3/8 in. Thick.	7/16 in. Thick.	1/2 in. Thick.	9/16 in. Thick.	5/8 in. Thick.	11/16 in. Thick.	3/4 in. Thick.	13/16 in. Thick.	7/8 in. Thick.	15/16 in. Thick.	1 in. Thick.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	·833	1·04	1·25	1·45	1·66	1·87	2·08	2·29	2·50	2·70	2·91	3·12	3·33
1 1/8	·937	1·17	1·40	1·64	1·87	2·10	2·34	2·57	2·81	3·04	3·28	3·51	3·75
1 1/4	1·04	1·30	1·56	1·82	2·08	2·34	2·60	2 86	3·12	3·38	3·64	3·90	4·16
1 3/8	1·14	1·43	1·71	2·	2·29	2·57	2·86	3·15	3 43	3·72	4·01	4·29	4·58
1 1/2	1·25	1·56	1·87	2·18	2·50	2·81	3·12	3·43	3·75	4·06	4·37	4·68	5·
1 5/8	1·35	1 69	2·03	2·36	2·70	3·04	3·38	3·72	4·06	4·40	4·73	5·07	5·41
1 3/4	1·45	1·82	2·18	2·55	2·91	3·28	3·64	4·01	4.37	4·73	5·10	5·46	5·83
1 7/8	1·56	1·95	2·34	2·73	3·12	3·51	3·90	4 29	4·68	5·07	5·46	5·85	6·25
2	1·66	2·08	2·50	2·91	3·33	3·75	4·16	4·58	5·	5·41	5·83	6·25	6·66
2 1/8	1·77	2·21	2·65	3·09	3·54	3 98	4·42	4·86	5·31	5·75	6·19	6·64	7·08
2 1/4	1·87	2·34	2·81	3·28	3·75	4 21	4·68	5·15	5·62	6·09	6·56	7 03	7·50
2 3/8	1·97	2·47	2·96	3·46	3·95	4·45	4·94	5·44	5·93	6·43	6·92	7·42	7·91
2 1/2	2·08	2·60	3·12	3·64	4·16	4·68	5·20	5·72	6·25	6·77	7.29	7 81	8·33
2 5/8	2·18	2·73	3·28	3·82	4·37	4·92	5·46	6·01	6·56	7·10	7·65	8·20	8·75
2 3/4	2·29	2·86	3·43	4·01	4·58	5·15	5·72	6·30	6·87	7·44	8·02	8·59	9·16
2 7/8	2·39	2·99	3·59	4·19	4·79	5·39	5·98	6·58	7·18	7·78	8·38	8 98	9·58
3	2·50	3·12	3·75	4·37	5·	5·62	6·25	6·87	7·50	8·12	8·75	9 37	10·

To ascertain the Weights of *larger sizes*, take the *half* size of that required, and double it. Thus, required the weight of 4 by 1 in.; refer to 2 by 1 in. = 6·66 × 2 = 13·32 lbs.

PLATE OR SHEET IRON, BRASS, COPPER, AND LEAD.

WEIGHT OF A SUPERFICIAL FOOT IN POUNDS AVOIRDUPOIS.

	THICKNESS IN PARTS OF AN INCH.											
Inch	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
Iron in lbs.	2·5	5.	7·5	10·	12·5	15·	17·5	20·	25·	30·	35·	40·
Brass ,, ...	2·7	5·5	8·2	10·9	13·6	16·3	19·	21·8	27·1	32·5	37·9	43·3
Copper ,, ...	2·9	5·8	8·7	11·6	14·5	17·4	20·3	23·2	28·9	34·7	40·4	46·2
Lead ,, ...	3·7	7·4	11·1	14·8	18·5	22.2	25·9	29·6	37·	44·4	57·8	59·2

	THICKNESS BY THE BIRMINGHAM WIRE-GAUGE, AND IN DECIMALS.													
Wire-gauge, No.	0000·	000·	00·	0.	1	2	3	4	5	6	7	8	9	10
Thickness in decimals of an inch......	·454	·425	·380	·340	·300	·284	·259	·238	·220	·203	·180	·165	·148	·134
Iron in lbs.	18·99	17·78	15·89	14·22	12·5	12·	11·	10·	8·74	8·12	7·5	6·86	6·24	5·62
Brass ,,	21·11	19·76	17·67	15·81	13·75	13·2	12·1	11·	9·61	8·93	8·25	7·54	6·86	6·18
Copper ,,	21·61	20·53	18·37	16·43	14·5	13·9	12·75	11·6	10·1	9·4	8·7	7·9	7·2	6·5
	THICKNESS BY THE BIRMINGHAM WIRE-GAUGE, AND IN DECIMALS.													
Wire-gauge, No.	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Thickness in decimals of an inch......	·120	·109	·095	·083	·072	·065	·058	·049	·042	·035	·032	·028	·025	·022
Iron in lbs.	5·	4·38	3·75	3·12	2·82	2·5	2·18	1·86	1·7	1·54	1·4	1·25	1·12	1·
Brass ,,	5·5	4·81	4·12	3·43	3·1	2·75	2·4	2·04	1·87	1·69	1·54	1·37	1·23	1·1
Copper ,,	5·8	5·08	4·34	3·6	3·27	2·9	2·52	2·15	1·97	1·78	1·62	1·45	1·3	1·16

HOOP IRON.

WEIGHT OF TEN LINEAL FEET.

Width in Inches and Parts . .	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2
No. of Gauge	21	20	19	18	17	16	15	14	13	12
Weight in lbs. and Decimal Parts	·685	·885	1·24	1·60	2·05	2·73	3·40	3·72	4·72	6·06

The weight of Bar Iron being 1 :—

The weight of	Cast Iron	=	·95
,,	Steel	=	1·02
,,	Copper	=	1·16
,,	Brass	=	1·09
,,	Lead	=	1·48

The weight of Cast Iron being 1 :—

The weight of	Bar Iron	=	1·07
,,	Steel	=	1·08
,,	Brass	=	1·16
,,	Copper	=	1·21
,,	Lead	=	1·56

WEIGHTS, OF 9 FEET LENGTH, OF FLANGED CAST-IRON PIPES OF VARIOUS DIAMETERS.

Diam. of Bore.	Thickness of Metal.	Diam. of Flange.	Thickness of Flange.	Diam. of Circ. through Holes.	Diam. of Holes.	Number of Holes.	Weight.
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.		Cwt. qr. lbs.
2	⅜	6½	9/16	4¾	⅝	4	0 3 0
3	⅜	7½	⅝	6	⅝	4	1 0 3
4	½	9½	¾	7¾	¾	4	1 3 5
5	½	10½	⅞	8¾	¾	4	2 1 12
6	⅝	12	⅞	10	⅞	4	3 2 1
7	⅝	14	1	11¾	⅞	6	4 3 17
8	¾	15	1	12¾	1	6	5 2 9
9	¾	16½	1 1/16	14¼	1	6	6 1 12
10	¾	17½	1⅛	15½	1	6	7 0 0
11	⅞	19	1 3/16	16¾	1	6	8 3 24
12	⅞	20	1¼	17¾	1⅛	6	9 3 5
13	⅞	21	1¼	18¾	1⅛	6	10 2 0
14	⅞	22	1¼	19¾	1⅛	8	11 0 26
15	⅞	23	1¼	20¾	1⅛	8	12 0 25
16	⅞	24½	1 5/16	22	1¼	8	12 3 8
17	⅞	25½	1 5/16	23	1¼	8	13 2 17
18	1	26½	1⅜	24	1¼	8	16 1 15
19	1	28	1⅜	25	1⅜	8	17 2 13
20	1	29	1⅜	26	1⅜	8	18 0 26

BALLS.—CAST-IRON, BRASS, COPPER, AND LEAD.

Diam.	Cast Iron.	Brass.	Copper.	Lead.	Diam.	Cast Iron.	Brass.	Copper.	Lead.	Diam.	Cast Iron.	Brass.	Copper.	Lead.
inch.	lbs.	lbs.	lbs.	lbs.	inch.	lbs.	lbs.	lbs.	lbs.	inch.	lbs.	lbs.	lbs.	lbs.
1	·136	·158	·166	·214	5	17·04	19·9	20·8	26·9	9	99·4	115·9	121·3	156·7
1½	·46	·537	·56	·727	5½	22·68	26·47	27·74	36·0	9½	116·9	136·4	143·0	184·7
2	1·09	1·25	1·3	1·7	6	29·45	34·3	35·9	46·4	10	136·35	159·0	166·4	215·0
2½	2·13	2·50	2·60	3·35	6½	37·44	43·67	45·76	59·13	10½	157·84	184·0	193·0	250·0
3	3·68	4·3	4·5	5·8	7	46·76	54·5	57·1	73·7	11	181·48	211·8	221·8	286·7
3½	5·84	6·82	7·14	9·23	7½	57·52	67·11	70·0	90·0	11½	207·37	242·0	253·5	327·7
4	8·72	10·2	10·7	13·8	8	69·81	81·4	85·2	110·1	12	235·62	275·0	288·1	372·3
4½	12·42	14·5	15·25	19·6	8½	83·73	100·0	102·3	132·3					

CAST-IRON PLATES.

WEIGHT OF A SUPERFICIAL FOOT, FROM ¼ TO 2 INCHES THICK.

Thick... Inch	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
Weight in Pounds	9·37	14·06	18·75	23·43	28·12	32·81	37·50	42·18	46·87	51·56	56·25	60·93	65·62	70.31	75

CAST-IRON PIPES, HOLLOW COLUMNS, OR CYLINDERS.

WEIGHT PER LINEAL FOOT.

Diameter of Bore.	¼ inch Thick.	⅜ inch Thick.	½ inch Thick.	⅝ inch Thick.	¾ inch Thick.	⅞ inch Thick.	1 inch Thick.	1¼ inch Thick.	1½ inches Thick.
in.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	3·06	5·06	7·36	9·97	12·89	16·11	19·63		
1¼	3·68	5·98	8·50	11·51	14·73	18·25	22·09		
1½	4·29	6·9	9·82	13·04	16·56	20·4	24·54		
1¾	4·91	7·83	11·05	14·57	18·41	22·55	27·		
2	5·53	8·75	12·25	16·11	20·25	24·7	29·45		
2¼	6·14	9·66	13·5	17·04	22·09	26·84	31·85		
2½	6·74	10·58	14·72	19·17	23·92	28·93	34·36		
2¾	7·36	11·5	15·95	20·7	25·71	31·14	36·81		
3	7·98	12·43	17·18	22·19	27·62	33·29	39·25	45·56	52·20
3¼	8·59	13·34	18·35	23·78	29·45	35·44	41·72	48·32	55·22
3½	9·2	14·21	19·64	25·81	31·3	37·58	44·18	51·08	58·29
3¾	9·76	15·19	20·86	26·85	33·13	39·73	46·63	53·84	61·36
4	10·44	16·11	22·1	28·38	34·98	41·88	49·00	56·61	64·25
4¼	11·1	17·08	23·37	29·97	36·87	44·08	51·6	59·42	67·45
4½	11·66	17·94	24·54	31·44	38·65	46·17	53·99	62·12	70·56
4¾	12·27	18·87	25·77	32·98	40·5	48·32	56·45	64·89	73·63
5	12·88	19·78	27·	34·51	42·25	50·46	58·9	67·64	76·25
5¼	13·5	20·71	28·23	36·05	44·18	52·62	61·36	70·41	79·77
5½	14·11	21·63	29·45	37·58	46·02	54·76	63·81	73·17	82·84
5¾	14·73	22·55	30·68	39·12	47·86	56·91	66·27	75·94	85·91
6	15·34	23·47	31·90	40·65	49·50	59·06	68·50	78·7	89·0
7	17·79	27·15	36·80	46·79	56·84	67·65	78·50	89·74	101·25
8	20·02	30·83	41·70	52·92	64·42	76·23	88·25	100·78	114·0
9	22·71	34·52	46·50	59·07	71·50	84·84	98·50	111·84	126·0
10	25·16	38·2	51·50	65·2	79·16	93·42	108·	122·87	138·00
11	27·62	41·88	56·25	71·33	86·50	102·01	117·50	133·92	150·30
12	30·06	45·55	61·	77·46	93·6	110·6	127·25	144·96	163·
14	...	...	...	90·6	109·6	129·	148·8	168·7	189·
16	...	...	...	...	124·5	146·4	168·6	181·0	213·8
18	...	...	...	...	139·4	163·7	188·4	213·3	238·5
20	...	...	...	...	...	181·1	208·2	235·6	263·3
24	...	...	...	...	182·	...	247·9	280·2	312·9
28	...	...	...	...	213·	...	286·	...	360
30	...	...	...	...	227·	...	305·	...	384
34	...	...	...	...	257·	...	345·	...	443

DIMENSIONS OF CYLINDRICAL COLUMNS OF CAST-IRON
TO SUSTAIN A GIVEN LOAD WITH SAFETY.

Diameter in inches.	Height in feet.											
	4	6	8	10	12	14	16	18	20	22	24	
2	72	60	49	40	82	26	22	18	15	13	11	Weight in cwts.
3	178	163	145	128	111	97	84	73	64	56	49	
4	326	310	288	266	242	220	198	178	160	144	130	
5	522	501	479	452	427	394	365	337	310	285	262	
6	607	592	573	550	525	497	469	440	413	386	360	
8	1333	1315	1289	1259	1224	1185	1142	1097	1052	1005	959	

N.B.—If the columns are hollow, the area to the given diameter is to be converted into the ring, or the difference of the outer and inner diameters multiplied by $\frac{3}{2}$, because hollow cast-iron columns are stronger than solid ones in that proportion.

TABLE OF THE STRONGEST FORM AND PROPORTION OF RIVETTED JOINTS.

Thickness of Plate.	Diameter of Rivet.	Length of Rivet.	Pitch.	Lap.
$\frac{3}{16}$ inch.	$\frac{3}{8}$ inch.	0·85 inches.	1·14 inches.	1·14 inches.
$\frac{1}{4}$ "	$\frac{1}{2}$ "	1·12 "	1·5 "	1·5 "
$\frac{5}{16}$ "	$\frac{5}{8}$ "	1·39 "	1·55 "	1·76 "
$\frac{3}{8}$ "	$\frac{3}{4}$ "	1·68 "	1·87 "	2·1 "
$\frac{1}{2}$ "	$\frac{3}{4}$ "	2·25 "	2·0 "	2·25 "
$\frac{5}{8}$ "	1 "	2·82 "	2·5 "	2·82 "
$\frac{3}{4}$ "	$1\frac{1}{8}$ "	3·37 "	3·0 "	3·37 "

SURFACE OF BOILER TUBES.

Diameter.	Length.		Surface.	Diameter.	Length.		Surface.
inches.	ft.	in.	square feet.	inches.	ft.	in.	square feet.
$2\frac{1}{2}$	5	0	3·27	3	6	0	4·70
"	5	3	3·42	"	6	3	4·90
"	5	6	3·60	"	6	6	5·10
"	5	9	3·75	"	7	0	5·50
"	6	0	3·90	"	7	6	5·89
"	6	3	4·05	"	8	0	6·28
"	6	6	4·20	"	8	6	6·67

DEPRECIATION OF MACHINERY.

Per Annum on First Cost.	Depreciation	Wear and Tear.	Total.
Engines	6 per cent.	3 per cent.	* 9 per cent.
Boilers	10 "	3 "	*13 "
Machine Tools	$7\frac{1}{2}$ "	$3\frac{1}{2}$ "	*11 "
Millwork, Shafting, and Gear . . .	4 "	$2\frac{1}{2}$ "	* $6\frac{1}{2}$ "
Bands and Belts	—	45 "	45 "

* Mr. Anderson (Woolwich Arsenal) considers 5 per cent. per annum ample, and the Authors' experience leads them to the same conclusion.

DECIMAL PARTS OF A SUPERFICIAL FOOT OF 144 INCHES REDUCED TO THEIR VALUE IN INCHES.

Inches.	Hundredth Parts.	Inches.	Hundredth Parts.	Inches.	Hundredth Parts.	Inches.	Hundredth Parts.
144	1·00	72	·50	13	·9	6	·4
130	·90	57	·40	11	·8	4·3	·3
115	·80	43	·30	10	·7	2·9	·2
100	·70	28	·20	9	·6	1·4	·1
87	·60	14	·10	7	·5		

DECIMAL PARTS OF A CWT. (112 lbs.)

Lbs.	Decimals.	Lbs.	Decimals.	Lbs.	Decimals.
84	·75	20	·178572	10	·089285
56	·5	19	·169643	9	·080357
28	·25	18	·160714	8	·071428
27	·241071	17	·151785	7	·0625
26	·232142	16	·142856	6	·053571
25	·223214	15	·133928	5	·044643
24	·214286	14	·125	4	·035714
23	·205357	13	·116071	3	·026786
22	·196428	12	·107143	2	·017857
21	·1875	11	·098214	1	·008928

DECIMAL PARTS OF A POUND (16oz.) REDUCED TO THEIR VALUE IN OUNCES.

Ounces.	Hundredth Parts.	Ounces.	Hundredth Parts.	Ounces.	Hundredth Parts.	Ounces.	Hundredth Parts.
1 lb. 16	1·00	¾ lbs. 12	·75	½ lb. 8	·50	¼ lb. 4	·25
15½	·97	11½	·72	7½	·46	3½	·22
15	·94	11	·69	7	·43	3	·19
14½	·90	10½	·65	6½	·40	2½	·15
14	·87	10	·62	6	·37	2	·12
13½	·84	9½	·59	5½	·34	1½	·09
13	·81	9	·56	5	·31	1	·06
12½	·78	8½	·53	4½	·28		

DECIMAL EQUIVALENTS TO FRACTIONAL PARTS OF LINEAL MEASURES.

ONE INCH, THE INTEGER OR WHOLE NUMBER.

Inch.	Decimals.	Inch.	Decimals.	Inch.	Decimals.	Inch.	Decimals.
⅞ and 3/32 =	·96875	⅝ and 3/32 =	·71875	⅜ and 3/32 =	·46875	⅛ and 3/32 =	·21875
⅞ and 1/16 =	·9375	⅝ and 1/16 =	·6875	⅜ and 1/16 =	·4375	⅛ and 1/16 =	·1875
⅞ and 1/32 =	·90625	⅝ and 1/32 =	·65625	⅜ and 1/32 =	·40625	⅛ and 1/32 =	·15625
⅞ =	·875	⅝ =	·625	⅜ =	·375	⅛ =	·125
¾ and 3/32 =	·84375	½ and 3/32 =	·59375	¼ and 3/32 =	·34375	3/32 =	·09375
¾ and 1/16 =	·8125	½ and 1/16 =	·5625	¼ and 1/16 =	·3125	1/16 =	·0625
¾ and 1/32 =	·78125	½ and 1/32 =	·53125	¼ and 1/32 =	·28125	1/32 =	·03125
¾ =	·75	½ =	·5	¼ =	·25		

ONE FOOT OR 12 INCHES THE INTEGER.

Inch.	Decimals.	Inch.	Decimals.	Inch.	Decimals.	Inch.	Decimals.
11 =	·9166	6 =	·5	1 =	·0833	⅜ =	·03125
10 =	·8333	5 =	·4166	⅞ =	·07291	¼ =	·02083
9 =	·75	4 =	·3333	¾ =	·0625	⅛ =	·01041
8 =	·6666	3 =	·25	⅝ =	·05208		
7 =	·5833	2 =	·1666	½ =	·04166		

DECIMAL APPROXIMATIONS FOR FACILITATING CALCULATIONS.

Lineal feet	multiplied by	·00019	= miles.
„ yards	„	·000568	= „
Square inches	„	·007	= square feet.
„ yards	„	·0002067	= „ acres.
Circular inches	„	·00546	= „ feet.
Cylindrical „	„	·0004546	= cubic feet.
„ feet	„	·02909	= „ yards.
Cubic inches	„	·00058	= „ feet.
„ feet	„	·03704	= „ yards.
„ „	„	6·232	= imperial galls.
„ inches	„	·003607	= „
Cylindrical feet	„	4·895	= „
„ inches	„	·002832	= „
Cubic „	„	·263	= lbs. avoir. of Cast Iron.
„ „	„	·281	= „ Wrought „
„ „	„	·283	= „ Steel.

Cubic inches	multiplied by	·3225	= lbs. avoir. Copper.
„ „	„	·3037	= „ Brass.
„ „	„	·26	= „ Zinc.
„ „	„	·4103	= „ Lead.
„ „	„	·2636	= „ Tin.
„ „	„	·4908	= „ Mercury.
Cylindrical „	„	·2065	= „ Cast Iron.
„ „	„	·2168	= „ Wrought Iron.
„ „	„	·2223	= „ Steel.
„ „	„	·2533	= „ Copper.
„ „	„	·2385	= „ Brass.
„ „	„	·2042	= „ Zinc.
„ „	„	·3223	= „ Lead.
„ „	„	·207	= „ Tin.
„ „	„	·3854	= „ Mercury.
Avoirdupois lbs.	„	·009	= cwts.
„ „	„	·00045	= tons.

MELTING POINTS &c. OF VARIOUS METALS.

Welding heat of Iron 13,420° Fahr. 1 foot in length contracts in cooling ·137 of an inch. Power of conducting heat to another body 37·41.

Cast Iron	melts at	2786° Fahr.	Contracts	in cooling	·125.	Conducting heat	65·76.
Copper	„	1996	„	„	·193.	„	89·82.
Brass	„	3807	„	„	·210.	„ about	„
Lead	„	612	„	„	·319.	„	17·96.
Tin	„	442	„	„	·278.	„	30·38.

Water expands in heating from 32° to 212°, about ·0434 of its bulk.

COMPARATIVE TABLE OF ENGLISH AND FOREIGN MEASURES.

LONG MEASURE.

	Equivalent in	English Feet.	Meters.	Prussian Feet.	Austrian Feet.
England, United States, Russia	1 foot = 12 inches	1·000	0·305	0·971	0·964
France, Belgium, Holland (Netherlands), Italy	1 meter = 10 decimeters = 100 centimeters = 1000 millimeters	3·281	1·000	3·186	·163
Sweden	1 foot = 10 inches = 100 lines	0·974	0·297	0·946	0·940
Prussia, Denmark, Norway	1 foot = 12 inches = 144 lines	1·029	0·314	1·000	0·993
Austria	1 foot = 10 inches = 100 lines	1·037	0·316	1·007	1·000
Spain, Peru	1 vara = 3 pies = 4 palmos = 36 pulgadas	2·738	0·835	2·659	2·642
Portugal, Brazil	1 vara = 5 palmos = 40 pollegados	3·934	1·100	3·503	3·481
Egypt	1 pik = 4 rub = 24 kirât	2·515	0·767	2·443	2·427
Persia	1 foot = 48 ving	1·665	0·508	1·618	1·608
Japan	1 kane sasi = 10 sun = 100 bun = 1000 rin	0·990	0·302	0·962	0·956
China	1 foot Imperial	1·052	0·321	1·022	1·016
	1 foot Public Works	1·045	0·319	1·016	1·009
	1 foot Merchants	1·098	0·335	1·067	1·060

1 English Mile	=	5280 feet English	=	1609 Meters.
1 Do. Nautical Mile 60 = 1° latitude	=	6080 „	=	1852 „
1 German ditto 15 = 1° ditto; 1 Dutch „ „ „	=	24302·4 „	=	7407 „
1 French League . 25 = 1° „	=	14580·8 „	=	4444 „
1 Prussian Mile	=	24712·5 „	=	7532 „
1 Austrian „	=	24889·7 „	=	7586 „
1 Swedish „	=	35067·3 „	=	10688 „
1 Spanish „	=	23183·5 „	=	7066 „
1 Russian Verst	=	3425·4 „	=	1043 „

COMPARATIVE TABLE OF ENGLISH AND FOREIGN MEASURES.

SUPERFICIAL MEASURE.

	Equivalent in	Feet English.	Meters.	Feet Prussian.	Feet Austrian.
England, United States, Russia	1 square foot	1·000	·0929	0·943	0·930
France, Belgium, Holland, Netherlands, Italy	1 square meter	10·764	1·000	10·152	10·007
Sweden	1 square foot	0·947	·0880	0·893	0·881
Prussia, Norway, Denmark	1 square foot	1·060	·0985	1·000	0·986
Austria	1 square foot	1·075	·0999	1·014	1·000
Spain, Peru	1 square vara	7·505	·6972	7·079	6·979
Portugal, Brazil	1 square vara	13·025	1·210	12·824	12·112
Egypt	1 square kassab	159·553	14·8225	150·482	148·373
Japan	1 square sasi	0·982	·0912	0·926	0·913
China	1 sq. engineer's foot	1·100	·1022	1·038	1·023

COMPARATIVE TABLE OF CUBIC MEASURES.

	Equivalent in	Cubic feet English.	Cubic Meters.	Cubic feet German.	Cubic feet Austrian.
England, United States, Russia	1 cubic foot	1·000	0·028	0·916	0·896
France, Belgium, Netherlands, Italy	1 cubic meter	35·316	1·000	32·346	31·768
Sweden	1 cubic foot	0·924	0·026	0·846	0·828
Prussia, Denmark, Norway	1 cubic foot	0·978	0·030	1·000	0·979
Austria	1 cubic foot	1·115	0·031	1·022	1·000
Spain, Peru	1 cubic vara	20·239	0·573	18·537	18·145
Portugal, Brazil	1 cubic vara	47·034	1·332	43·080	43·445
Egypt	1 cubic kassab	15·933	0·451	14·593	14·423
Persia	1 cubic foot	4·629	0·131	4·240	4·276
Japan	1 cubic sasi	0·973	0·027	0·898	0·872
China	1 cub. engineer's foot	1·151	0·033	1·045	1·032

COMPARATIVE AVERAGE VALUE OF ENGLISH AND FOREIGN COIN.

	Equivalent in	English.			French.		German.		Austrian.		Russian.		American.	
		£	s.	d.	fr.	cen.	th.	kr.	gul.	kr.	roub.	kop.	dol.	cent.
England	12 pence = 1 shilling; 20 shillings = £1 =	1	0	0	25	00	6	20	10	00	6	14	4	66
France, Belgium, Switzerland	100 centimes = 1 franc =	0	0	9½	1	00	0	8	0	40	0	24½	0	18¾
Italy	100 centissime = 1 lira =													
Prussia, Germany	30 silbergroschen = 1 thaler =	0	3	0	3	75	1	0	1	50	0	92	0	70
Austria	100 kreutzers = 1 gulden =	0	2	0	2	50	0	20	1	00	0	62	0	46⅔
Russia	100 kopeks = 1 rouble =	0	3	3	4	07	1	2½	1	63	1	00	0	76
Netherlands and Dutch Possessions	100 cents = 1 gulden =	0	1	8½	2	12	0	17	0	85	0	52	0	39 2/10
Hamburg	16 schillings = 1 marc banco =	0	1	6	1	89	0	15	0	76	0	47	0	35
Denmark	16 schilling = 1 rigsbankthaler =	0	2	3	2	84	22	8	1	14	0	70	0	53
Sweden	100 ore = 1 riksdaler =	0	1	1¾	1	43	0	11½	0	57	0	35	0	27
Norway	5 ort = 1 speciesthaler =	0	4	6	5	68	1	15½	2	28	1	40	1	06
Spain	20 reals = 1 duro =	0	4	2	5	40	1	12½	2	13	1	30	1	00
Portugal	1000 reis = 1 milreis =	0	4	8	5	83	1	14	2	19	1	44	1	09
Turkey	40 para = 1 piaster =	0	0	2	0	22	0	1¾	0	09	0	06	0	04
Egypt	10 piasters = 1 bididlik =	0	4	8	5	83	1	14	2	19	1	44	1	09
Persia	5 abasse = 1 rupee =	0	2	0	2	50	0	20	1	00	0	62	0	46⅔
China	10 maces = 1 tal =	0	6	0½	7	63	2	1⅜	3	07	1	90½	1	42
Japan	18 momme = 1 itsibu =	0	1·4		1	66	0	13⅛	0	70	0	41½	0	31
India	16 annas = 1 rupee =	0	1	10½	2	33	0	18¾	0	93	0	58	0	43½
America—														
United States	100 cents = 1 dollar =	0	4	3½	5	35	1	12¾	2	14	1	32	1	0
Mexico	100 cents = 1 piaster =													

COMPARISON OF ENGLISH AND FRENCH WEIGHTS AND MEASURES IN COMMON USE.

WEIGHTS.

1 gramme .... = 15·434 grains or ·0022 lbs. avoirdupois.
1 kilogramme .... = 2·2048 lbs. or ·01969 cwt.
1 quintal .... = 1 cwt. 3 qrs. 24½ lbs.
1 lb. avoirdupois .... = ·4535 kilogrammes.
1 cwt. .... = 50·787 kilogrammes.
1 ton .... = 1015·965 kilogrammes.
1 ton English × 0·984 .... = 1 ton French.

DRY AND FLUID MEASURES.

1 litre (a cubic decimetre) ... = 61·028 cubic inches, or = 1·761 imperial pints
Gallons .... = litres × 4·543.
Cubic inches .... = litres × 0·0163

VARIOUS FRENCH MEASURES IN COMMON USE.

A point	is equal to	·0148025	English inches.	
A line	,,	·088815	,,	
A millimetre	,,	·039371	,,	
A centimetre	,,	·39371	,,	
An inch (pouce)	,,	1·06578	,,	
A decimetre	,,	3·9371	,,	
A foot	,,	12·78933	,,	
A metre	,,	39·371	,,	or 3·2809 English feet.
A toise (fathom)	,,	6·394	English feet.	
A league	,,	14591·1	,,	or 4863·7 English yards.
A square inch	,,	1·13582	English square inches.	
A cubic inch	,,	1·21063	English cubic inches.	
A cubic metre	,,	35·316	English cubic feet.	

MEASURES OF SURFACE, OR SQUARE MEASURE.

144	square	inches	= 1	square	foot.
9	,,	feet	= 1	,,	yard.
30¼	,,	yards	= 1	,,	pole.
40	,,	poles	= 1	,,	rood.
4	,,	roods, or 10 square chains, or 4840 square yards	= 1	,,	acre.
640	,,	acres	= 1	,,	mile.
1069	Scotch	,,	= 1369	English	acres.

MEASURES OF SOLIDITY, OR CUBIC MEASURE.

1728 cubic inches	= 1 cubic foot.		64000 cubic poles	= 1 cubic furlong.
27 ,, feet	= 1 ,, yard.		512 ,, furlongs	= 1 ,, mile.
166⅜ ,, yards	= 1 ,, pole.			

MEASURES OF CAPACITY.

For all Liquid and all Dry Goods, except those in Next Table.

8·665 cubic inches		= $\frac{5}{16}$ lbs. of water	= 1 gill.
4 gills	= 34·659 cubic inches	= 1¼ ,,	= 1 pint.
2 pints	= 69·318 ,,	= 2½ ,,	= 1 quart.
4 quarts	= 277¼ ,,	= 10 ,,	= 1 gallon.
2 gallons	= 554½ ,,	= 20 ,,	= 1 peck.
4 pecks	= 2218½ ,,	= 80 ,,	= 1 bushel.
8 bushels	= 10¼ cubic feet		= 1 quarter.
5 quarters	= 51¼ ,,		= 1 load.

A bushel of wheat is on average 60 lbs.; barley, 47 to 50 lbs.; oats, 38 to 40 lbs.
A load of hay or straw, 36 trusses.
A truss of straw is 36 lbs. weight; old hay, 56 lbs.; new hay (until 1st September), 60 lbs.
A hogshead of wine, about 52½ gallons; a puncheon, 70; a pipe, 105 gallons.

IMPERIAL MEASURES OF CAPACITY.

For Potatoes, Fruit, and other Goods.

2 Gallons	= 1 Peck	= 704 cubic inches nearly.
8 ,,	= 1 Bushel	= 2815½ ,,
3 Bushels	= 1 Sack	= 5 cubic feet nearly.
12 Sacks	= 1 Chaldron	= 58⅔ ,,

The imperial gallon is exactly 10 lbs. avoirdupois of pure water; the pint 1¼ lb.; and the bushel 80 lbs.

MEASURES OF WEIGHT—TROY.

Used for Precious Metals.

4 grains (marked gr.)	=	1 carat	(marked	car.)
24 ,,	=	1 pennyweight	,,	dwt.
20 pennyweights	=	1 ounce	,,	oz.
12 ounces	=	1 pound	,,	lb.

AVOIRDUPOIS.

Used in all Mercantile Transactions, and in the Common Dealings of Life.

27·34375 troy grains	=	1 dram	(marked	dr.)
16 drams	=	1 ounce	,,	oz.
16 ounces	=	1 pound	,,	lb.
14 pounds	=	1 stone	,,	st.
2 stones, or 28 pounds	=	1 quarter	,,	qr.
4 quarters, or 112 pounds	=	1 hundredweight	,,	cwt.
20 hundredweights	=	1 ton	,,	T. or ton.

MISCELLANEOUS SPECIAL BRITISH MEASURES.

6 lineal feet		=	1 fathom.
100 square feet		=	1 square of flooring.
272 ,,	at 14 inches in thickness	=	1 rod of brickwork.
600 ,,	of 1 inch boards	=	1 load.
40 cubic feet of round timber } 50 ,, of hewn timber }		=	1 ton or load.
40 ,,		=	1 ton of shipping.
500 bricks		=	1 load.
32 bushels of lime		=	1 ,,
36 ,, of sand		=	1 ,,
22 cwt.		=	1 fodder of lead (Stockton).
21 ,,		=	1 ,, (Newcastle).
19½ ,,		=	1 ,, (London).
36 bushels, or 28 cwt.		=	1 chaldron of coals (London).
53 cwt.		=	1 ,, (Newcastle).
83 lbs.		=	1 bushel of coal.
56 ,,		=	1 ,, of flour or salt.
gallon of sea water		=	10·32 lbs. avoirdupois.
,, oil		=	9·32 ,,
1 ,, proof spirits		=	9·3 ,,

The old ale gallon contained 282 cubic inches; and the old wine gallon 231.

The French litre, or standard measure of capacity for liquids, contains 61·028 cubic inches, or about ·453 of the imperial gallon.

WEIGHT OF WATER.

Maximum density of water at 42° Fahrenheit.

Freezing point 32° Fahrenheit, at which point it has expanded $\frac{1}{17}$th of its original bulk.

62·5 lbs. avoirdupois	=	the weight of	1 cubic foot of water	= 6¼ imperial gallons.
·03617 ,,	=	,,	1 cubic inch of water.	
·434 ,,	=	,,	1 lineal foot 1 inch square.	
49·1 ,,	=	,,	1 cylindrical foot	= about 5 imperial gallons.
·02842 ,,	=	,,	1 cylindrical inch.	
·341 ,,	=	,,	1 lineal foot 1 inch diameter.	
11·2 imperial gallons	=	,,	1 cwt.	
224· ,,	=	,,	1 ton.	
1·8 cubic feet	=	,,	1 cwt.	
35·84 ,,	=	,,	1 ton.	

1 circular inch	= 1·273	square inch.
1 cubic foot	= 2200·	cylindrical inches
1 ,,	= 3300·	spherical ,,
1 ,,	= 6600·	conical ,,

PROPERTIES OF MATERIALS.

	Specific Gravity.	Weight of a Cube Foot in lbs.	Weight of a Cube Inch in lbs.	Tenacity in lbs. per square inch.	Crushing Force in lbs. per square inch.
METALS—					
Aluminium	2·56	160·	·092		
Antimony, Cast	6·7	418·9	·242	1066	
Arsenic	5·76	360·2	·208		
Bismuth, Cast	9·82	615·	·356	3250	
Brass, Cast	8·4	525·	·303	17978	10300
Brass Wire	8·5	531·	·307	49000	
Bronze	8·22	513·4	·297		
Cobalt, Cast	7·81	488·2	·282		
Copper, Cast	8·89	555·	·321	19072	11700
Copper, Sheet	8·95	559·	·323	33000	
Copper Wire	9·	562·	·325	61000	
Gold, Pure	19·25	1203·6	·7	20400	
Gold, Hammered	19·36	1210·1	·7		
Gold, Standard	17·64	1102·9	·638		
Gun Metal	8·4	525·	·303	36000	
Iron, Wrought (Bar)	7·7	481·	·28	60000	38000
Iron, Swedish	7·6	475·	·275	70000	
Iron Wire				85000	
Iron, Cast	7·18	448·	·259	19000	92000
Lead, Cast	11.38	709·	·41	1824	7000
Lead, Sheet				3328	
Mercury, Solid	15·63	977·	·565		
Mercury, Fluid	13·56	848·	·49		
Nickel, Cast	7·8	487·9	·282		
Platinum, Pure	19·5	1218·8	·705		
Platinum, Hammered	20·33	1271·	·735		
Silver, Pure	10·47	654·6	·38	41000	
Silver, Hammered	10·51	656·9	·38		
Silver, Standard	10·53	658·4	·381		
Steel, Tempered	7·81	488·6	·282	120000	
Steel, Soft	7·83	489·6	·283		
Steel, Puddled	7·78	485·	·282	80000	
Tin, Cast	7·29	455·7	·262	5000	15000
Type Metal	10·45	653·1	·378		
Zinc	7·	437·	·253	8000	
STONES, EARTHS, &c.—					
Basaltes	27·22	170·1	·1		
Borax	17·14	107·1	·062		
Brick	2·	124·	·071	290	1500
Brickwork in Mortar	1·6	100·	·058	50	
Brickwork in Cement	1·8	112· to 94·	·062	290	1000
Concrete, Ordinary	1·9	119·	·069		
Concrete in Cement	2·2	133·	·077		
Cement, Portland	1·3	81·	·048	290	1000
Cement, Roman	1·	63·	·036		
Chalk	2·3	143·	·082		400
Clay	2·	125·	·071		
Coal	1·3	82·	·048		
Coke	·8	50·	·029		
Cutler's Stone	2·11	131·9	·076		
Emery	4·	250·	·144		
Earth, Rammed	1·6	100·	·058		
Flint	2·6	163·	·094		
Freestone	2·45	153·3	·089		
Gypsum	2·17	135·5	·078		
Granite (mean of fourteen sorts)	2·69	168·6	·097		8000
Grindstone	2·14	133·9	·077		
Limestone	2·94	184·1	·11		3000 to 8000

PROPERTIES OF MATERIALS—*continued.*

	Specific Gravity.	Weight of a Cube Foot in lbs.	Weight of a Cube Inch in lbs.	Tenacity in lbs. per square inch.	Crushing Force in lbs. per square inch.
STONES, EARTHS, &c.—*continued.*					
Marble (mean of nineteen sorts)	2·72	170·	·1	6000	6000
Millstone	2·48	155·3	·089		
Peat, Hard	1·32	83·1	·049		
Porphyry	2·72	170·2	·1		
Pumice Stone	·915	57·2	·033		
Purbeck Stone	2·6	162·6	·094		
Rag Stone	2·47	154.4	·089		
Rotten Stone	1·98	123·8	·071		
Salt	2·13	133·1	·077		
Sand	1·9	120·	·07		
Sandstone	2·5	156·	·089		5000
Slate	2·8	175·	·1	9000	11000
Stone, Bath	1·8	112·	·065		
Stone, Common	2·52	157·5	·091		
Stone, Portland	2·57	160·1	·092		
Shingle	1·4	90·	·052		
Sulphur, Native	2·03	127·1	·073		
Sulphur, Melted	1·99	124·4	·072		
WOODS—					
Acacia and Orange Tree	·71	44·4	·025		
Ash and Dantzic Oak	·76	50·	·029	17200	9000
Beech	·7	43·8	·025	11000	9000
Birch, Common	·7	43·8	·025	15000	5500
Birch, American Black	·75	46·9	·027		
Box and Greenheart	1·	62·5	·036		
Cedar	·48	31·	·018	11000	5600
Cherry Tree	·715	44·7	·025		
Cork	·24	15·	·009		
Deal, Christiana	·68	43·	·025	12000	6000
Deal, Memel	·39	36·9	·021		
Ebony	1·27	79·4	·046		
Elm and Larch	·54	33·8	·019	13000	10000
Fir, New England	·55	34·4	·02		
Fir, Riga, and Maple	·75	46·9	·027		
Fir, Mar Forest	·70	43·8	·025		
Hornbeam	·75	47·	·027	20000	7000
Lignum Vitæ	1·33	83·3	·049		
Logwood	·913	57·1	·033		
Mahogany, Spanish	·8	50·	·029	16000	8000
Norway Spars	·58	36·3	·021		
Oak, English	·93	58·	·033	17000	10000
Oak, Canadian	·87	54·5	·032	10000	6000
Oak, African	·98	61·3	·035		
Oak, Adriatic	·99	61·9	·036		
Pear Tree	·646	40·4	·023		
Pine, Red	·65	41·	·023	12000	5800
Pine, Yellow	·45	29·	·016	11000	5400
Poon and Hazel	·6	37·5	·021		
Poplar	·456	28·5	·016		
Plum Tree	·75	46·9	·027		
Teak, Moulmein	·65	41·	·023	15000	12000
Walnut	·67	41·9	·023		
Willow	·585	36·6	·021	8000	
Yew	·798	49·9	·028		
GASES, LIQUIDS, &c.—					
Atmospheric Air	·0012	·075			
Azotic Gas	·00118	·074			
Carbonic Acid Gas	·00182	·614			
Muriatic Acid Gas	·00153	·096			

PROPERTIES OF MATERIALS—*continued.*

	Specific Gravity.	Weight of a Cube Foot in lbs.	Weight of a Cube Inch in lbs.	Tenacity in lbs. per square inch.	Crushing Force in lbs. per square inch.
GASES, LIQUIDS, &c.—*continued.*					
Nitrous Acid Gas	·00291	·182			
Sulphurous Acid Gas	·00276	·172			
Hydrogen Gas	·0001	·006			
Oxygen Gas	·00143	·09			
Acid, Acetic	1·063	66·4	·038		
Acid, Muriatic	1·2	75·	·043		
Acid, Nitric	1·271	79·4	·046		
Acid, Phosphoric	1·558	97·4	·056		
Acid, Sulphuric	1·85	115·6	·067		
Alcohol, Absolute	·797	49·8	·029		
Alcohol, Highly Rectified	·829	51·8	·03		
Alcohol of Commerce	·837	52·3	·03		
Ammoniac, Liquid	·897	56·1	·033		
Beer	1·028	64·3	·037		
Cyder	1·018	63·6	·036		
Ether, Acetic	·866	54·1	·031		
Ether, Muriatic	·73	45·6	·026		
Ether, Sulphuric	·74	46·3	·027		
Milk	1·032	64·5	·037		
Oil of Aniseed	·987	61·6	·035		
Oil of Caraway Seed	·905	56·6	·033		
Oil of Cinnamon	1·044	65·3	·038		
Oil of Lavender	·894	55·9	·033		
Oil of Linseed	·940	58·8	·034		
Oil of Mint	·898	56·1	·033		
Oil of Olives	·915	57·2	·033		
Oil of Turpentine	·87	54·9	·032		
Oil of Whale	·923	57·7	·033		
Vinegar	1·010	63·1	·036		
Water, Distilled	1·0	62·5	·036		
Water, Sea	1·026	64·1	·037		
Wine, Champagne	·998	62·4	·036		
Wine, Madeira	1·038	64·9	·037		
Wine, Port	·997	62·3	·036		
RESINS, GUMS, &c—					
Assafœtida	1·328	83·	·048		
Asphaltum	·9	56·	·033		
Bees' Wax	·967	60·4	·035		
Bone of an Ox	1·656	103·5	·06		
Butter	·942	58·9	·034		
Camphor	·989	61·8	·035		
Copal	1·077	67·3	·039		
Fat	·93	58·1	·034		
Gamboge	1·222	76·4	·044		
Gum Arabic	1·452	90·8	·052		
Gum, Ammoniac	1·207	75·4	·043		
Gum Lac	1·139	71·2	·041		
Gunpowder, Shaken	·932	58·3	·034		
Gunpowder, Solid	1·745	109.1	·062		
Gutta Percha	·98	61·	·035		
Honey	1·45	90·6	·052		
Indigo	·769	48·1	·022		
India Rubber	·934	58·4	·034		
Ivory, Dry	1·825	114·1	·066		
Lard	·948	59·3	·034		
Madder Root	·765	47·8	·022		
Opium	1·336	83·5	·048		
Sandarac	1·092	68·3	·036		
Spermaceti	·943	58·9	·034		
Sugar, White	1·606	100·4	·058		
Tallow	·942	58·9	·034		
Tar	1·015	63·4	·036		
Wax, Shoemakers'	·897	56·1	·033		

ON MANUAL AND ANIMAL POWER.

THE force derived from the muscular exertion, or strength of men and animals, having been the first power applied as a prime mover of machinery, although superseded by its more powerful rivals, steam, air, and water, still continues, in a great many cases, the only available source from which power can be obtained.

When work has to be done without the intervention of compound machines, as where a load is carried directly by a man or animal, or where their power is employed in traction or to turn a crank, or work a pump, it is a great desideratum to know the amount of force they are capable of exerting in any given direction. But so much must always depend on the organization and training of living animals, that no fixed laws can possibly be laid down on this subject. All we can do is to give results deduced from actual experiments, and even these vary so considerably, that only an average can be taken. The results here given are collected from experiments made by Coulomb, Smeaton, Desaguliers, Watt, Poncelet, and others, and have been adopted, and, for the most part, verified in actual practice by the authors. Climate seems to have a very decided influence on the strength of men, so much so that under 14° latitude a man can only perform half the work he can in our own climate. The quantities given in the tables of manual and animal powers respectively, are those of an average Englishman of 150 lbs. weight and a stout cart horse.

An animal will support the greatest load when standing still, when it moves, a part of its strength must be expended in giving that motion, and on the other hand there is a speed at which the whole energy of the animal will be expended in moving its own weight at that velocity, it is clear therefore, that the greatest mechanical effect will be obtained somewhere between these two extremes. Maschek obtained the best effect when the working load equalled one-third the greatest load the animal could support, moved at one-third the greatest velocity at which the animal was capable of moving its own weight, and this might be continued for one-third of a day, or eight hours. This formula, however, requires considerable modification in practice to suit itself to the varying circumstances which continually present themselves, and where the effort is required during a short period, this load may with advantage be doubled. In comparing steam-power with horse-power, the standard usually employed is the number of foot pounds which Watt found a horse equivalent to, viz.,.33,000 pounds raised one foot high in a minute. Desaguliers makes the numbers equal 44,000; Smeaton, 22,916. Watt's number, however, is universally adopted in England. The power of a man was estimated by Desaguliers, at 6,600 foot pounds; by other authors at about 5,000 foot pounds; Dr. Gregory gives 5,500, or 6 men equal one horse, and this may be safely adopted under ordinary circumstances.

In the following tables the number given in the first column is the net weight transported, or the effective pressure maintained throughout. When a horse is made to move in a circle or horse-walk, as in line 15, care should be taken to keep the diameter of the circle as large as practicable, the animal being obliged to move sideways as well as forward, his labour becomes more fatiguing as the diameter decreases; a horse can walk in a circle of 18 feet diameter, but only under great disadvantage, it ought never to be less than from 24 to 30 feet; in the larger walk he will travel at the rate of 2½ or 3 miles per hour. The height of the draught-bar should be about ⅘ths the height of the animal.

ON MANUAL AND ANIMAL POWER—*continued.*

WORK OF MEN.

No.	Kind of Work.	Load in pounds.	Speed in feet per minute.	Duration of work in hours.
1	Walking on level and carrying load . . .	90	180	7
2	Carrying load upstairs	145	20	6
3	Wheeling load in barrow	336	100	8
4	Walking and drawing a load (tractive force in lbs.)	70	120	8
5	Pushing at a capstan-bar	50	120	8
6	Turning a crank or crane handle	30	200	10
7	Two men ditto, handles at right angles . .	90	100	5 mins.
8	Pulling at a vertical rope	40	90	8
9	Work a lever or pump handle	14	150	10
10	Raising weights by hand	40	90	8
	WORK OF HORSES.			
11	Walking, drawing a loaded cart	2000	220	10 hours.
12	Trotting, ditto, ditto	800	440	4
13	Dead Pull (tractive force)	420		
14	Lifting a weight over a pulley	200	220	8
15	Pulling at a lever and walking in a circle . .	150	200	8
16	Walking, carrying a load	270	220	10
17	Trotting, ditto ditto	180	440	6

The power of other animals may be compared with horses in the following proportions :—

OXEN, same load as a horse, speed two-thirds that of a horse.

MULE, one half the load of a horse, speed same as a horse.

ASS, one fourth the load of a horse, speed same as a horse.

TABLE

To calculate the Pitch of a Toothed Wheel when the radius and number of teeth are given; and the Radius, when the pitch and number of teeth are given, from 10 to 159 teeth.

No. of Teeth.	Radius.	No. of Teeth.	Radius.	No. of Teeth.	Radius.	No. of Teeth.	Radius.	No. of Teeth.	Radius.
10	1·618	40	6·373	70	11·144	100	15·918	130	20·692
11	1·774	41	6·532	71	11 303	101	16·077	131	20 851
12	1·932	42	6 691	72	11·463	102	16·236	132	21·010
13	2·089	43	6·850	73	11·622	103	16·395	133	21·169
14	2·247	44	7·009	74	11·781	104	16 554	134	21·328
15	2·405	45	7·168	75	11·940	105	16·713	135	21·488
16	2·563	46	7·327	76	12·099	106	16·873	136	21·647
17	2·721	47	7·486	77	12·258	107	17·032	137	21·806
18	2·879	48	7·645	78	12·417	108	17·191	138	21·965
19	3·038	49	7·804	79	12·576	109	17·350	139	22·124
20	3·196	50	7·963	80	12·735	110	17·509	140	22·283
21	3·355	51	8·122	81	12·895	111	17·668	141	22·442
22	3·513	52	8·281	82	13·054	112	17 827	142	22·602
23	3·672	53	8·440	83	13·213	113	17·987	143	22·761
24	3·830	54	8·599	84	13·370	114	18·146	144	22·920
25	3·989	55	8·758	85	13·531	115	18 305	145	23·079
26	4·148	56	8·917	86	13·690	116	18·464	146	23·238
27	4·307	57	9·076	87	13·849	117	18·623	147	23·397
28	4·465	58	9·235	88	14·008	118	18·782	148	23·556
29	4·624	59	9·394	89	14·168	119	18·941	149	23 716
30	4·788	60	9·553	90	14·327	120	19·101	150	23·875
31	4·942	61	9 712	91	14·486	121	19 260	151	24 034
32	5·101	62	9·872	92	14·645	122	19·419	152	24·193
33	5·260	63	10·031	93	14·804	123	19·578	153	24·352
34	5·419	64	10·190	94	14 963	124	19·737	154	24·511
35	5·578	65	10·349	95	15·122	125	19·896	155	24·620
36	5·737	66	10 508	96	15·281	126	20 055	156	24·830
37	5·896	67	10·667	97	15·440	127	20·214	157	24·989
38	6·055	68	10·826	98	15·600	128	20·374	158	25·148
39	6·214	69	10·985	99	15 759	129	20·533	159	25·307

Rule 1.—Divide the required radius by the radius opposite the given number of teeth in the table; the quotient will be the required pitch of the wheel.

Example.—To find the pitch of a wheel whose radius is 43 inches, that shall contain 90 teeth:

Required radius 43 ÷ 14·327 = 3 inch pitch.

Rule 2.—Multiply the radius opposite the given number of teeth in the table by the pitch required; the product will be the required radius of the wheel.

Example.—To find the radius of a wheel that shall contain 48 teeth of 2½ inch pitch:

In the table, radius 7·645 × 2·5 = $19\frac{1}{10}$ inches nearly.

TABLE OF THE DIAMETERS OF SHAFTS, BEING THE FIRST MOVERS.

Horse Power.	REVOLUTIONS.																			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
	DIAMETERS OF SHAFTS IN INCHES.																			
4	5·5	4·8	4·5	4·	3·7	3·8	3·5	3·3	3·2	3·1	3·	2·9	2·9	2·8	2·7	2·7	2·6	2·6	2·6	2·5
5	5·9	5·1	4·7	4·4	4·1	3·9	3·7	3·6	3·5	3·3	3·3	3·2	3·1	3·	3·	2·9	2·9	2·8	2·8	2·7
6	6·3	5·5	5·	4·6	4·4	4·1	4·	3·8	3·7	3·6	3·5	3·5	3·4	3·3	3·2	3·2	3·	3·	2·9	2·9
7	6·6	5·3	5·2	4·9	4·6	4·4	4·2	4·	3·9	3·7	3·6	3·6	3·5	3·4	3·4	3·3	3·3	3·2	3·1	3·1
	6·9	6·	5·5	5·1	4·8	4·6	4·4	4·2	4·1	4·	3·9	3·8	3·7	3·6	3·5	3·5	3·4	3·4	3·3	3·2
5	7·2	6·3	5·7	5·5	5·	4·8	4·5	4·4	4·2	4·1	4·	3·8	3·7	3·7	3·6	3·6	3·5	3·5	3·4	3·3
10	7·4	6·6	5·9	5·6	5·2	4·9	4·7	4·6	4·4	4·2	4·1	4·	3·9	3·8	3·7	3·7	3·6	3·6	3·5	3·4
12	7·9	6·9	6·3	5·8	5·6	5·4	5·2	5·	4·8	4·6	4·4	4·3	4·2	4·1	4·	3·9	3·8	3·8	3·7	3·6
14	8·3	7·2	6·7	6·2	5·9	5·6	5·4	5·2	5·	4·7	4·5	4·4	4·4	4·3	4·2	4·1	4·	4·	3·9	3·8
16	8·7	7·6	7·1	6·6	6·1	5·8	5·6	5·4	5·2	5·	4·8	4·7	4·6	4·5	4·4	4·4	4·3	4·2	4·1	4·
18	9·	7·9	7·5	7·	6·6	6·2	5·8	5·6	5·4	5·2	5·	4·9	4·8	4·7	4·6	4·5	4·4	4·3	4·2	4·2
20	9·3	8·1	7·7	7·2	6·8	6·4	5·9	5·7	5·6	5·4	5·2	5·1	5·	4·8	4·6	4·6	4·5	4·5	4·4	4·4
25	10.	8·5	8·	7·4	7·1	6·8	6·3	6·	5·9	5·6	5·5	5·4	5·3	5·2	5·1	4·9	4·8	4·7	4·6	4·6
30	10·7	9·3	8·4	7·9	7·4	7·1	6·9	6·7	6·5	6·3	5·9	5·8	5·7	5·6	5·5	5·3	5·2	5·1	5·	4·9
35	11·4	9·8	8·9	8·4	7·9	7·4	7·1	6·9	6·6	6·5	6·3	6·1	5·9	5·7	5·6	5·5	5·4	5·3	5·2	5·2
40	11·7	10·5	9·3	8·8	8·3	7·8	7·4	7·2	6·9	6·7	6·6	6·4	6·2	6·	5·9	5·8	5·7	5·6	5·6	5·5
45	12·	10·6	9·7	9·2	8·7	8·1	7·6	7·4	7·	6·8	6·7	6·5	6·4	6·2	6·1	6·	5·9	5·8	5·7	5·6
50	12·6	11·	10·	9·3	9·	8·5	8·	7·8	7·4	7·3	7·2	6·9	6·8	6·6	6·5	6·4	6·2	6·	5·9	5·8
55	13·4	11·4	10·4	9·8	9·1	8·8	8·4	8·	7·5	7·4	7·3	7·2	7·	6·7	6·6	6·5	6·3	6·2	6·1	6·
60	13·6	12·	10·8	10·	9·3	9·	8·6	8·2	7·7	7·6	7·4	7·3	7·2	6·9	6·8	6·8	6·7	6·6	6·4	6·2

The diameters of shafts used as second movers, or for driving machinery, will be found by dividing the numbers in the table by 1·25.

The diameters of small shafts in mills, &c. will be found by dividing the numbers by 1·56.

APPLEBY'S TABLE *showing the* NUMBER *of* GALLONS DISCHARGED PER MINUTE *by a Single-Acting Pump of a given Diameter and Stroke at* 10 *Strokes per Minute.*

LENGTH OF STROKE IN INCHES.

Diameter of Pump Barrel in inches.	1	2	3	4	5	6	7	8	9	10	12	14	15	16	18	20	24	Diameter of Pump Barrel in inches.
1	·028	·056		·112	·140	·168	·196	·224	·252	·280	·336	·392	·420	·448	·504	·560	·672	1
1¼	·044	·088	·132	·176	·220	·264	·308	·352	·396	·44	·528	·616	·660	·704	·792	·88	1·056	1¼
1½	·063	·126	·189	·252	·315	·378	·441	·504	·567	·63	·756	·882	·945	1·008	1·134	1·26	1·572	1½
1¾	·086	·172	·258	·344	·430	·516	·602	·688	·774	·86	1·032	1·204	1·29	1·376	1·548	1·72	2·064	1¾
2	·113	·226	·339	·452	·565	·678	·791	·904	1·017	1·13	1·356	1·582	1·695	1·808	2·034	2·26	2·712	2
2½	.176	·352	·528	·704	·880	1·056	1·232	1·408	1·574	1·76	2·112	2·464	2·64	2·816	3·148	3·52	4·224	2½
3	.254	·508	·762	1·016	1·270	1·524	1·778	2·032	2·286	2·54	3·048	3·55	3·81	4·06	4·57	5·08	6·09	3
3½	·346	·692	1·038	1·384	1·730	2·07	2·42	2·76	3·11	3·46	4·15	4·84	5·19	5·52	6·22	6·92	8·30	3½
4	·452	·91	1·35	1·82	2·26	2·71	3·16	3·61	4·06	4·52	5·42	6·32	6·78	7·22	8·12	9·04	10·84	4
4½	·572	1·14	1·71	2·29	2·86	3·43	4·00	4·57	5·14	5·72	6·86	8·0	8·57	9·14	10·28	11·44	13·72	4½
5	·7	1·4	2·1	2·8	3·5	4·2	4·9	5·6	6·3	7·	8·4	9·8	10·5	11·2	12·6	14·0	16·8	5
5½	·8	1·70	2·55	3·40	4·25	5·10	5·95	6·8	7·65	8·5	10·2	11·9	12·75	13·6	15·3	17·0	20·4	5½
6	1·01	2·02	3·03	4·04	5·05	6·06	7·07	8·08	9·09	10·1	12·12	14·14	15·15	16·16	18·18	20·20	24·24	6
7	1·38	2·77	4·15	5·54	6·92	8·31	9·69	11·08	12·06	13·85	16·62	19·38	20·77	22·16	24·12	27·7	33·24	7
8	1·80	3·61	5·42	7·23	9·04	10·85	12·66	14·47	16·28	18·09	21·7	25·32	27·13	28·94	32·56	36·18	42·14	8
9	2·289	4·57	6·86	9·15	11·44	13·73	16·02	18·31	20·60	22·89	27·46	32·04	34·33	36·62	41·2	45·78	54·92	9
10	2·827	5·45	8·48	11·30	14·13	16·96	19·78	22·61	25·44	28·27	33·92	39·56	42·40	45·22	50·88	56·54	67·84	10
12	4·068	8·13	12·20	16·27	20·34	24·40	28·47	32·54	36·61	40·68	48·8	56·94	61·02	65·08	73·22	81·36	97·6	12
15	6·361	12·72	19·08	25·44	31·80	38·16	44·52	50·88	57·24	63·61	76·32	89·04	95·41	101·76	114·48	127·22	152·64	15
18	9·158	18·31	27·47	36·63	45·79	54·94	64·10	73·26	82·42	91·58	109·88	128·2	137·37	146·52	164·84	183·16	219·76	18
20	11·307	22·61	33·921	45·23	56·53	67·84	79·15	90·45	101·76	113·07	135·68	158·3	169·6	180.9	203·5	226·14	271·36	20
24	16·282	32·56	48·84	65·12	81·41	99·69	113·97	130·25	146·53	162·82	195·4	227·9	244·23	260·5	293·0	325·6	390·8	24
	1	2	3	4	5	6	7	8	9	10	12	14	15	16	18	20	24	inches.

The Quantities given in the Table are in gallons, and are calculated for Single-Acting Pumps at 10 Strokes per minute; if required for Double-Acting Pumps, the number found in the Table should be doubled. The quantity for any other number of strokes may be found by multiplying or dividing the number found in the Table.

TABLE

SHOWING THE QUANTITY OF WATER PER LINEAR FOOT IN PUMPS OR VERTICAL PIPES OF DIFFERENT DIAMETERS.

Diameter of Pump in inches.	Number of gallons per linear foot.	Number of cubic feet per linear foot.	Diameter of Pump in inches.	Number of gallons per linear foot.	Number of cubic feet per linear foot.
2	·136	·0218	8	2·176	·3490
2¼	·172	·0276	8¼	2·314	·3712
2½	·212	·0340	8½	2·456	·3940
2¾	·257	·0412	8¾	2·603	·4175
3	·306	·0490	9	2·754	·4417
3¼	·359	·0576	9¼	2.909	·4666
3½	·416	·0688	9½	3·068	·4923
3¾	·478	·0766	9¾	3·232	·5184
4	·544	·0872	10	3·400	·5454
4¼	·614	·0985	10¼	3·572	·5730
4½	·688	·1104	10½	3·748	·6013
4¾	·767	·1230	10¾	3·929	·6302
5	·850	·1363	11	4·114	·6599
5¼	·937	·1503	11¼	4·303	·6902
5½	1·028	·1649	11½	4·496	·7212
5¾	1·124	·1803	11¾	4·694	·7529
6	1·224	·1963	12	4·896	·7853
6¼	1·328	·2130	12½	5·312	·8521
6½	1·436	·2304	13	5·746	·9217
6¾	1·549	·2489	13½	6·196	·9939
7	1·666	·2672	14	6·664	1·0689
7¼	1·787	·2866	15	7·650	1·2271
7½	1·912	·3067	16	8·704	1·3962
7¾	2·042	·3275	18	11·016	1·7670

TABLE

SHOWING THE POWER IN FOOT POUNDS REQUIRED TO RAISE A GIVEN QUANTITY OF WATER A GIVEN HEIGHT.

Height in Feet.	NUMBER OF GALLONS RAISED PER MINUTE.											Height in Feet.
	1	2	3	4	5	10	20	30	40	50	100	
1	20	40	60	80	100	175	300	425	550	675	1200	1
2	30	60	90	120	150	275	500	750	950	1175	2200	2
3	40	80	120	160	200	375	700	1025	1350	1675	3200	3
4	50	100	150	200	250	475	900	1325	1750	2175	4200	4
5	60	120	180	240	300	575	1100	1625	2150	2675	5200	5
10	110	220	330	440	550	1076	2102	3128	4154	5180	10210	10
20	210	420	630	840	1050	2076	4102	6128	8154	10180	20210	20
30	310	620	930	1240	1550	3076	6102	9128	12154	15180	30210	30
40	410	820	1230	1640	2050	4076	8102	12128	16154	20180	40210	40
50	510	1020	1530	2040	2550	5076	10102	15128	20154	25180	50210	50
100	1010	2020	3030	4040	5050	10076	20102	30128	40154	50180	100210	100

The Numbers given in the Table are in foot lbs. including allowance for friction.

A foot pound = 1 lb. raised 1 foot high in 1 minute.

A man is capable of exerting 6000 ft. lbs. for 10 hours a day. 33000 ft. lbs. = 1 H. P.

TABLE OF DIAMETERS, AREAS, AND CIRCUMFERENCES OF CIRCLES,

AND OF

SQUARES, CUBES, SQUARE ROOTS AND CUBE ROOTS.

Number.	Circumference.	Area.	Square.	Cube.	Square Root.	Cube Root.	Number.	Circumference	Area.	Square.	Cube.	Square Root.	Cube Root
1	3·14	0·79	1	1	1·000	1·000	61	191·64	2922·47	3721	226981	7·810	3·936
2	6·28	3·14	4	8	1·414	1·260	62	194·78	3019·07	3844	238328	7·874	3·957
3	9·42	7·07	9	27	1·732	1·442	63	197·92	3117·25	3969	250047	7·937	3·979
4	12·57	12·57	16	64	2·000	1·587	64	201·06	3216·99	4096	262144	8·000	4·000
5	15·71	19·63	25	125	2·236	1·710	65	204·20	3318·31	4225	274625	8·062	4·020
6	18·85	28·27	36	216	2·450	1·817	66	207·35	3421·19	4356	287496	8·124	4·041
7	21·99	38·48	49	343	2·646	1·913	67	210·49	3525·65	4489	300763	8·185	4·061
8	25·13	50·27	64	512	2·828	2·000	68	213·63	3631·68	4624	314432	8·246	4·081
9	28·27	63·62	81	729	3·000	2·080	69	216·77	3739·28	4761	328509	8·306	4·101
10	31·42	78·54	100	1000	3·162	2·154	70	219·91	3848·45	4900	343000	8·367	4·121
11	34·56	95·03	121	1331	3·317	2·224	71	223·05	3959·19	5041	357911	8·426	4·140
12	37·70	113·10	144	1728	3·464	2·289	72	226·19	4071·50	5184	373248	8·485	4·160
13	40·84	132·73	169	2197	3·605	2·351	73	229·34	4185·39	5329	389017	8·544	4·179
14	43·98	153·94	196	2744	3·741	2·410	74	232·48	4300·84	5476	405224	8·602	4·198
15	47·12	176·72	225	3375	3·872	2·466	75	235·62	4417·86	5625	421875	8·660	4·217
16	50·27	201·06	256	4096	4·000	2·519	76	238·76	4536·46	5776	438976	8·717	4·235
17	53·41	226·98	289	4913	4·123	2·571	77	241·90	4656·63	5929	456533	8·775	4·254
18	56·55	254·47	324	5832	4·242	2·620	78	245·04	4778·36	6084	474552	8·831	4·272
19	59·69	283·53	361	6859	4·358	2·668	79	248·19	4901·67	6241	493039	8·888	4·290
20	62·83	314·15	400	8000	4·472	2·714	80	251·33	5026·55	6400	512000	8·944	4·309
21	65·97	346·36	441	9261	4·582	2·758	81	254·47	5153·00	6561	531441	9·000	4·326
22	69·12	380·13	484	10648	4·690	2·802	82	257·61	5281·02	6724	551368	9·055	4·344
23	72·26	415·48	529	12167	4·795	2·843	83	260·75	5410·61	6889	571787	9·110	4·362
24	75·40	452·39	576	13824	4·898	2·884	84	263·89	5541·77	7056	592704	9·165	4·379
25	78·54	490·87	625	15625	5·000	2·924	85	267·04	5674·50	7225	614125	9·219	4·396
26	81·68	530·93	676	17576	5·099	2·962	86	270·18	5808·80	7396	636056	9·273	4·414
27	84·82	572·56	729	19683	5·196	3·000	87	273·32	5944·69	7569	658503	9·327	4·431
28	87·96	615·75	784	21952	5·291	3·036	88	276·46	6082·12	7744	681472	9·380	4·447
29	91·11	660·52	841	24389	5·385	3·072	89	279·60	6221·14	7921	704969	9·433	4·461
30	94·25	706·86	900	27000	5·477	3·107	90	282·74	6361·72	8100	729000	9·487	4·481
31	97·89	754·77	961	29791	5·567	3·141	91	285·89	6503·88	8281	753571	9·539	4·497
32	100·53	804·25	1024	32768	5·657	3·174	92	289·03	6647·61	8464	778688	9·591	4·514
33	103·67	855·30	1089	35937	5·744	3·207	93	292·17	6792·91	8649	804357	9·643	4·530
34	106·82	907·92	1156	39304	5·830	3·239	94	295·31	6939·78	8836	830584	9·695	4·546
35	109·96	962·11	1225	42875	5·916	3·271	95	298·45	7088·22	9025	857375	9·746	4·562
36	113·10	1017·88	1296	46656	6·000	3·301	96	301·59	7238·23	9216	884736	9·797	4·578
37	116·24	1075·21	1369	50653	6·082	3·332	97	304·73	7389·81	9409	912673	9·848	4·594
38	119·38	1134·11	1444	54872	6·164	3·361	98	307·87	7542·96	9604	941192	9·899	4·610
39	122·52	1194·59	1521	59319	6·244	3·391	99	311·02	7697·69	9801	970299	9·949	4·626
40	125·66	1256·64	1600	64000	6·324	3·419	100	314·16	7853·98	10000	1000000	10·000	4·642
41	128·81	1320·25	1681	68921	6·403	3·448	101	317·30	8011·85	10201	1030301	10·049	4·657
42	131·95	1385·44	1764	74088	6·480	3·476	102	320·44	8171·28	10404	1061208	10·099	4·672
43	135·09	1452·20	1849	79507	6·557	3·503	103	323·58	8332·29	10609	1092727	10·148	4·687
44	138·23	1520·53	1936	85184	6·633	3.530	104	326·73	8494·87	10816	1124864	10·198	4·702
45	141·37	1590·43	2025	91125	6·708	3·556	105	329·87	8659·01	11025	1157625	10·246	4·717
46	144·51	1661·90	2116	97336	6·782	3·583	106	333·01	8824·73	11236	1191016	10·295	4·732
47	147·66	1734·94	2209	103823	6·856	3·609	107	336·15	8992·02	11449	1225043	10·344	4·747
48	150·80	1809·56	2304	110592	6·928	3·634	108	339·29	9160·88	11664	1259712	10·392	4·762
49	153·94	1885·74	2401	117649	7·000	3.659	109	342·43	9331·32	11881	1295029	10·440	4·776
50	157·08	1963·50	2500	125000	7·071	3·684	110	345·58	9503·32	12100	1331000	10·488	4·791
51	160·22	2042·82	2601	132651	7·141	3·708	111	348·72	9676·89	12321	1367631	10·536	4·806
52	163·36	2123·72	2704	140608	7·211	3·732	112	351·86	9852·03	12544	1404928	10·583	4·820
53	166·50	2206·18	2809	148877	7·280	3·756	113	355·00	10028·75	12769	1442897	10·630	4·834
54	169·65	2290·22	2916	157464	7·348	3·779	114	358·14	10207·03	12996	1481544	10·677	4·848
55	172·79	2375·83	3025	166375	7·416	3·802	115	361·28	10386·89	13225	1520875	10·723	4·862
56	175·93	2463·01	3136	175616	7·483	3·825	116	364·42	10568·32	13456	1560896	10·770	4·876
57	179·07	2551·76	3249	185193	7·549	3·848	117	367·56	10751·82	13689	1601613	10·816	4·890
58	182·21	2642·08	3364	195112	7·615	3·870	118	370·70	10935·88	13924	1643032	10·862	4·904
59	185·35	2733·97	3481	205379	7·681	3·892	119	373·85	11122·02	14161	1685159	10·908	4·918
60	188·50	2827·43	3600	216000	7·746	3·915	120	376·99	11309·73	14400	1728000	10·954	4·932

TABLE OF DIAMETERS, AREAS, &c.—*continued.*

Number.	Circumference.	Area.	Square.	Cube.	Square Root.	Cube Root.
121	380.13	11499·01	14641	1771561	11·000	4·946
122	383·27	11689·87	14884	1815848	11·045	4·959
123	386·41	11882·29	15129	1860867	11·090	4·973
124	389·56	12076·28	15376	1906624	11·135	4·986
125	392·70	12271·85	15625	1953125	11·180	5·000
126	395·84	12468·98	15876	2000376	11·224	5·013
127	398·98	12667·69	16129	2048383	11·269	5·026
128	402·12	12867·96	16384	2097152	11·314	5·039
129	405·27	13069·81	16641	2146689	11·357	5·052
130	408·41	13273·23	16900	2197000	11·401	5·065
131	411·55	13478·22	17161	2248091	11·445	5·078
132	414·69	13684·78	17424	2299968	11·489	5·091
133	417·83	13892·91	17689	2352637	11·532	5·104
134	420·97	14102·61	17956	2406104	11·575	5·117
135	424·12	14313·88	18225	2460375	11·618	5·129
136	427·26	14526·72	18496	2515456	11·661	5·142
137	430·40	14741·14	18769	2571353	11·704	5·155
138	433·54	14957·12	19044	2620872	11·747	5·167
139	436·68	15174·68	19321	2685619	11·789	5·180
140	439·82	15393·80	19600	2744000	11·832	5·192
141	442·96	15614·50	19881	2803221	11·874	5·204
142	446·11	15836·77	20164	2863288	11·916	5·217
143	449·25	16060·61	20449	2924207	11·958	5·229
144	452·39	16286·02	20736	2985984	12·000	5·241
145	455·53	16513·00	21025	3048625	12·041	5·253
146	458·67	16741·55	21316	3112136	12·083	5·265
147	461·81	16971·67	21609	3176523	12·124	5·277
148	464·96	17203·36	21904	3241792	12·165	5·289
149	468·10	17436·62	22201	3307949	12·206	5·301
150	471·24	17671·46	22500	3375000	12·247	5·313
151	474·38	17907·86	22801	3442951	12·288	5·325
152	477·52	18145·84	23104	3511808	12·328	5·336
153	480·66	18385·39	23409	3581577	12·369	5·348
154	483·81	18626·50	23716	3652264	12·409	5·360
155	486·95	18869·19	24025	3723875	12·449	5·371
156	490·09	19113·45	24336	3796416	12·489	5·383
157	493·23	19359·28	24649	3869893	12·529	5·394
158	496·37	19606·68	24964	3944312	12·569	5·406
159	499·51	19855·65	25281	4019679	12·609	5·417
160	502·65	20106·19	25600	4096000	12·649	5·428
161	505·80	20358·31	25921	4173281	12·688	5·440
162	508·94	20611·99	26244	4251528	12·727	5·451
163	512·08	20867·19	26569	4330747	12·767	5·462
164	515·22	21124·07	26896	4410944	12·806	5·473
165	518·36	21382·47	27225	4492125	12·845	5·484
166	521·50	21642·43	27556	4574296	12·884	5·495
167	524·65	21904·0	27889	4657463	12·922	5·506
168	527·79	22167·1	28224	4741632	12·961	5·517
169	530·93	22431·8	28561	4826809	13·000	5·528
170	534·07	22698·0	28900	4913000	13·038	5·539
171	537·21	22965·8	29241	5000211	13·076	5·550
172	540·36	23235·2	29584	5088448	13·114	5·561
173	543·50	23506·2	29929	5177717	13·152	5·572
174	546·64	23778·7	30276	5268024	13·190	5·582
175	549·78	24052·8	30625	5359375	13·228	5·593
176	552·92	24328·5	30976	5451776	13·266	5·604
177	556·06	24605·7	31329	5545233	13·304	5·614
178	559·20	24884·6	31684	5639752	13·341	5·625
179	562·34	25164·9	32041	5735339	13·379	5·635
180	565·49	25446·9	32400	5832000	13·416	5·646
181	568·63	25730·4	32761	5929741	13·453	5·656
182	571·77	26015·5	33124	6028568	13·490	5·667
183	574·91	26302·2	33489	6128487	13·527	5·677
184	578·05	26590·4	33856	6229504	13·564	5·687
185	581·19	26880·3	34225	6331625	13·601	5·698

Number.	Circumference.	Area.	Square.	Cube.	Square Root	Cube Root.
186	584·34	27171·6	34596	6434856	13·638	5·708
187	587·48	27464·6	34969	6539203	13·674	5·718
188	590·62	27759·1	35344	6644672	13·711	5·728
189	593·76	28055·2	35721	6751269	13·747	5·738
190	596·90	28352·9	36100	6859000	13·784	5·748
191	600·04	28652·1	36481	6967871	13·820	5·758
192	603·19	28952·9	36864	7077888	13·856	5·768
193	606·33	29255·3	37249	7189057	13·892	5·778
194	609·47	29559·2	37636	7301384	13·928	5·788
195	612·61	29864·8	38025	7414875	13·964	5·798
196	615·75	30171·9	38416	7529536	14·000	5·808
197	618·89	30480·5	38809	7645373	14·035	5·818
198	622·04	30790·7	39204	7762392	14·071	5·828
199	625·18	31102·6	39601	7880599	14·106	5·838
200	628·32	31415·9	40000	8000000	14·142	5·848
201	631·46	31730·9	40401	8120601	14·177	5·857
202	634·60	32047·4	40804	8242408	14·212	5·867
203	637·74	32365·5	41209	8365427	14·247	5·877
204	640·88	32685·1	41616	8489664	14·282	5·886
205	644·03	33006·4	42025	8615125	14·317	5·896
206	647·17	33329·2	42436	8741816	14·352	5·905
207	650·31	33653·5	42849	8869743	14·387	5·915
208	653·45	33979·5	43264	8998912	14·422	5·924
209	656·59	34307·0	43681	9123329	14·456	5·934
210	659·63	34636·1	44100	9261000	14·491	5·943
211	662·87	34966·7	44521	9393931	14·525	5·953
212	666·01	35298·9	44944	9528128	14·560	5·962
213	669·16	35632·7	45369	9663597	14·594	5·972
214	672·30	35968·1	45796	9800344	14·628	5·981
215	675·44	36305·0	46225	9938375	14·662	5·990
216	678·58	36643·5	46656	10077696	14·696	6·000
217	681·73	36983·6	47089	10218313	14·730	6·009
218	684·87	37325·3	47524	10360232	14·764	6·018
219	688·01	37668·5	47961	10503459	14·798	6·027
220	691·15	38013·3	48400	10648000	14·832	6·036
221	694·29	38359·6	48841	10793861	14·866	6·045
222	697·43	38707·6	49284	10941048	14·899	6·055
223	700·57	39057·1	49729	11089567	14·933	6·064
224	703·71	39408·1	50176	11239424	14·966	6·073
225	706·86	39760·8	50625	11390625	15·000	6·082
226	710·00	40115·0	50076	11543176	15·033	6·091
227	713·14	40470·8	51529	11697083	15·066	6·100
228	716·28	40828·1	51984	11852352	15·099	6·109
229	719·42	41187·1	52441	12008989	15·132	6·118
230	722·57	41547·6	52900	12167000	15·165	6·126
231	725·71	41909·6	53361	12326391	15·198	6·135
232	728·85	42273·3	53824	12487168	15·231	6·144
233	731·99	42638·5	54289	12649337	15·264	6·153
234	735·13	43005·3	54756	12812904	15·297	6·162
235	738·27	43373·6	55225	12977875	15·329	6·171
236	741·42	43743·5	55696	13144256	15·362	6·179
237	744·56	44115·0	56169	13312053	15·394	6·188
238	747·70	44488·1	56644	13481272	15·427	6·197
239	750·84	44862·7	57121	13651919	15·459	6·205
240	753·98	45238·9	57600	13824000	15·491	6·214
241	757·12	45616·7	58081	13997521	15·524	6·223
242	760·27	45996·1	58564	14172488	15·556	6·231
243	763·41	46377·0	59049	14348907	15·588	6·240
244	766·55	46759·5	59536	14526784	15·620	6·248
245	769·69	47143·5	60025	14706125	15·652	6·257
246	772·83	47529·2	60516	14886936	15·684	6·265
247	775·97	47916·4	61009	15069223	15·716	6·274
248	779·11	48305·1	61504	15252992	15·748	6·282
249	782·26	48695·5	62001	15438249	15·779	6·291
250	785·40	49087·4	62500	15625000	15·311	6·299

REGISTRATION OF DESIGNS.

	Term of Protection.	Cost of Certificate. £ s. d.
Ornamental designs in iron	5 years	1 0 0
Ditto, in wood, glass, earthenware, ivory, bone, papier maché, and solid substances	3 years	1 0 0

Two drawings or specimens, exactly alike, are sent in, one of which is retained at the office, and the other returned to the proprietor, with the certificate and mark; the latter must be copied on each registered article, but the use of it after the registration has expired is prohibited under a penalty of £1 to £5.

BRITISH AND FOREIGN PATENTS.

A British patent affords protection in Great Britain, Ireland, the Channel Islands, and the Isle of Man, and the cost of securing "provisional protection" for six months, including the stamp of £5 and agent's fee, is from £8 to £10. "Notice to proceed" must be given within four months of the date of the provisional protection, the cost of which, including the £5 stamp and agent's fee, is usually about £6. A further payment of £10 for the "warrant and seal" stamp, and about £2 10s. for agent's fees, must be made not later than fourteen days before the expiration of the provisional protection, and a patent is then granted for three years from the date when the provisional protection was taken out. At this stage drawings of the invention have to be supplied, the cost of which will necessarily vary, and is defrayed by the patentee, but the total cost of a patent for 3 years will usually amount to about £30.

If the patent is upheld, a sum of £50 has to be paid for the stamp, which protects it for a further period of four years, and at the expiration of that time it may be again prolonged for seven years on payment of £100.

The term of the British patent is 14 years, and the total cost is from £180 to £190, but it may be abandoned at any time, the patentee incurring no liability beyond the payments actually made.

FOREIGN PATENTS.

The laws vary as regards the time when application should be made for a patent which has been published in another country, but it is always desirable to take out patents as nearly as possible at or about the same time in each country.

	Cost of Patent. £ s. d.
AMERICA.—A patent for the United States is granted for 17 years, and the application must be accompanied by a model or specimen of the invention	21 10 0

	Cost of Patent. £	s.	d.
AUSTRIA.—Including one year's tax, one year being allowed to work the invention, and by paying an annual tax the patent may be upheld for 15 years	11	10	0
BAVARIA.—Including two years' tax	12	10	0
And by paying an annual tax the patent may be upheld for 15 years.			
BELGIUM.—Including one year's tax	2	15	0
Patents are granted for 20 years, and the tax is payable by annuities; the first year 10 francs, the second year 20 francs, and so on, increasing 10 francs per year.			
BRAZIL.—Including tax for the 5 years	19	0	0
Patents are granted for 15 years.			
CEYLON.—Including tax for 14 years, the whole period of the patent	30	0	0
DENMARK.—Including tax for 5 years	18	0	0
Patent granted for 10 years.			
FRANCE.—Including first year's tax	6	10	0
Patents granted for 15 years, and kept in force by an annual payment of £4. Two years allowed for working the invention.			
HOLLAND.—Including tax for 5 years	14	0	0
Ditto 10 years	27	0	0
Ditto 15 years	55	0	0
and a patent taken for the shorter period may be extended, 1½ years allowed for payment of the tax, and two years for working the invention.			
INDIA.—Including tax for 14 years, the whole period of the patent	30	0	0
ITALY.—Including first annual tax, and 3 years proportional tax	12	0	0
NEW SOUTH WALES.—Including tax for 7 to 14 years, whole duration of patent	35	0	0
NORWAY.—Including tax for 5 to 10 years, the whole duration of patents	18	0	0
PORTUGAL.—Including tax for 5 years	27	0	0
Patents granted for 5, 10, or 15 years.			
PRUSSIA.—Including tax for 5 to 6 years, the whole duration of patents	7	10	0
RUSSIA.—Including tax for 3 years	30	0	0
Patents granted for 3, 5, or 10 years.			
SAXONY.—Including tax for 5 years	11	10	0
Patents granted for 10 years.			
SPAIN.—Including tax for 5 years	24	10	0
Patents granted for 5, 10, or 15 years.			
SWEDEN.—Including tax for 3 to 15 years, the whole duration of patent	18	0	0

A CONCISE TABLE for CALCULATING the VALUE of GOODS,

SOLD BY THE HUNDREDWEIGHT AVOIRDUPOIS, FROM 1/0 TO 56/0 PER CWT.

RATE.									
Per ton.	Per cwt.	2 qrs.	1 qr.	14 lbs.	7 lbs.	4 lbs.	3 lbs.	2 lbs.	1 lb.
£ s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	d.	d.	d.	d.
1 0 0	1 0	0 6	0 3	0 1½	0 0¾	0¼	0¼		
1 10 0	1 6	0 9	0 4½	0 2¼	0 1	0½	0¼	0¼	
2 0 0	2 0	1 0	0 6	0 3	0 1½	0¾	0½	0¼	
2 6 8	2 4	1 2	0 7	0 3½	0 1¾	1	0¾	0½	0¼
2 10 0	2 6	1 3	0 7½	0 3¾	0 1¾	1	0¾	0½	0¼
3 0 0	3 0	1 6	0 9	0 4½	0 2¼	1¼	0¾	0½	0¼
3 10 0	3 6	1 9	0 10½	0 5¼	0 2½	1½	1	0¾	0¼
4 0 0	4 0	2 0	1 0	0 6	0 3	1½	1¼	0¾	0¼
4 10 0	4 6	2 3	1 1½	0 6¾	0 3¼	1¾	1¼	0¾	0¼
4 13 4	4 8	2 4	1 2	0 7	0 3½	2	1½	1	0½
5 0 0	5 0	2 6	1 3	0 7½	0 3¾	2	1½	1	0½
5 10 0	5 6	2 9	1 4½	0 8¼	0 4	2¼	1¾	1	0½
6 0 0	6 0	3 0	1 6	0 9	0 4½	2½	1¾	1¼	0½
6 10 0	6 6	3 3	1 7½	0 9¾	0 4¾	2¾	2	1¼	0½
7 0 0	7 0	3 6	1 9	0 10½	0 5¼	3	2¼	1½	0¾
7 10 0	7 6	3 9	1 10½	0 11¼	0 5½	3	2¼	1½	0¾
8 0 0	8 0	4 0	2 0	1 0	0 6	3¼	2½	1½	0¾
8 10 0	8 6	4 3	2 1½	1 0¾	0 6¼	3½	2½	1¾	0¾
9 0 0	9 0	4 6	2 3	1 1½	0 6¾	3¾	2¾	1¾	0¾
9 6 8	9 4	4 8	2 4	1 2	0 7	4	3	2	1
9 10 0	9 6	4 9	2 4½	1 2¼	0 7	4	3	2	1
10 0 0	10 0	5 0	2 6	1 3	0 7½	4¼	3	2	1
10 10 0	10 6	5 3	2 7½	1 3¾	0 7¾	4½	3¼	2¼	1
11 0 0	11 0	5 6	2 9	1 4½	0 8¼	4½	3½	2¼	1
11 10 0	11 6	5 9	2 10½	1 5¼	0 8½	4¾	3½	2¼	1
11 13 4	11 8	5 10	2 11	1 5½	0 8¾	5	3¾	2½	1¼
12 0 0	12 0	6 0	3 0	1 6	0 9	5	3¾	2½	1¼
12 10 0	12 6	6 3	3 1½	1 6¾	0 9¼	5¼	4	2½	1¼
13 0 0	13 0	6 6	3 3	1 7½	0 9¾	5½	4	2¾	1¼
13 10 0	13 6	6 9	3 4½	1 8¼	0 10	5¾	4¼	2¾	1¼
14 0 0	14 0	7 0	3 6	1 9	0 10½	6	4½	3	1½
14 10 0	14 6	7 3	3 7½	1 9¾	0 10¾	6	4½	3	1½
15 0 0	15 0	7 6	3 9	1 10½	0 11¼	6½	4¾	3	1½
15 10 0	15 6	7 9	3 10½	1 11¼	0 11½	6½	4¾	3¼	1½
16 0 0	16 0	8 0	4 0	2 0	1 0	6¾	5	3½	1½
16 6 8	16 4	8 2	4 1	2 0½	1 0¼	7	5¼	3½	1¾
16 10 0	16 6	8 3	4 1½	2 0¾	1 0¼	7	5¼	3½	1¾
17 0 0	17 0	8 6	4 3	2 1½	1 0¾	7¼	5½	3½	1¾
17 10 0	17 6	8 9	4 4½	2 2¼	1 1	7½	5½	3¾	1¾
18 0 0	18 0	9 0	4 6	2 3	1 1½	7½	5¾	3¾	1¾
18 10 0	18 6	9 3	4 7½	2 3¾	1 1¾	7¾	5¾	3¾	1¾
18 13 4	18 8	9 4	4 8	2 4	1 2	8	6	4	2
19 0 0	19 0	9 6	4 9	2 4½	1 2¼	8	6	4	2
19 10 0	19 6	9 9	4 10½	2 5¼	1 2½	8¼	6¼	4	2

A CONCISE TABLE FOR CALCULATING THE VALUE OF GOODS,—*continued.*

RATE.

Per ton.	Per cwt.	2 qrs.	1 qr.	14 lbs.	7 lbs.	4 lbs.	3 lbs.	2 lbs.	1 lb.
£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	d
20 0 0	1 0 0	0 10 0	5 0	2 6	1 3	0 8½	0 6¼	0 4¼	2
21 0 0	1 1 0	0 10 6	5 3	2 7½	1 3¾	0 9	0 6¾	0 4½	2¼
22 0 0	1 2 0	0 11 0	5 6	2 9	1 4½	0 9¼	0 7	0 4½	2¼
23 0 0	1 3 0	0 11 6	5 9	2 10½	1 5¼	0 9¾	0 7¼	0 4¾	2¼
23 6 8	1 3 4	0 11 8	5 10	2 11	1 5½	0 10	0 7½	0 5	2½
24 0 0	1 4 0	0 12 0	6 0	3 0	1 6	0 10¼	0 7½	0 5	2½
25 0 0	1 5 0	0 12 6	6 3	3 1½	1 6¾	0 10½	0 8	0 5¼	2½
25 13 4	1 5 8	0 12 10	6 5	3 2½	1 7¼	0 11	0 8¼	0 5½	2¾
26 0 0	1 6 0	0 13 0	6 6	3 3	1 7½	0 11	0 8¼	0 5½	2¾
27 0 0	1 7 0	0 13 6	6 9	3 4½	1 8¼	0 11½	0 8½	0 5¾	2¾
28 0 0	1 8 0	0 14 0	7 0	3 6	1 9	1 0	0 9	0 6	3
29 0 0	1 9 0	0 14 6	7 3	3 7½	1 9¾	1 0¼	0 9¼	0 6	3
30 0 0	1 10 0	0 15 0	7 6	3 9	1 10½	1 0¾	0 9½	0 6¼	3
30 6 8	1 10 4	0 15 2	7 7	3 9½	1 10¾	1 1	0 9¾	0 6½	3¼
31 0 0	1 11 0	0 15 6	7 9	3 10½	1 11¼	1 1¼	0 9¾	0 6½	3¼
32 0 0	1 12 0	0 16 0	8 0	4 0	2 0	1 1½	0 10¼	0 6¾	3¼
32 13 4	1 12 8	0 16 4	8 2	4 1	2 0½	1 2	0 10½	0 7	3½
33 0 0	1 13 0	0 16 6	8 3	4 1½	2 0¾	1 2	0 10½	0 7	3½
34 0 0	1 14 0	0 17 0	8 6	4 3	2 1½	1 2½	0 10¾	0 7¼	3½
35 0 0	1 15 0	0 17 6	8 9	4 4½	2 2¼	1 3	0 11¼	0 7½	3¾
36 0 0	1 16 0	0 18 0	9 0	4 6	2 3	1 3¼	0 11½	0 7½	3¾
37 0 0	1 17 0	0 18 6	9 3	4 7½	2 3¾	1 3¾	0 11¾	0 7¾	3¾
37 6 8	1 17 4	0 18 8	9 4	4 8	2 4	1 4	1 0	0 8	4
38 0 0	1 18 0	0 19 0	9 6	4 9	2 4½	1 4¼	1 0	0 8	4
39 0 0	1 19 0	0 19 6	9 9	4 10½	2 5¼	1 4½	1 0½	0 8¼	4
39 13 4	1 19 8	0 19 10	9 11	4 11½	2 5¾	1 5	1 0¾	0 8½	4¼
40 0 0	2 0 0	1 0 0	10 0	5 0	2 6	1 5	1 0¾	0 8½	4¼
41 0 0	2 1 0	1 0 6	10 3	5 1½	2 6¾	1 5½	1 1	0 8¾	4¼
42 0 0	2 2 0	1 1 0	10 6	5 3	2 7½	1 6	1 1½	0 9	4½
44 6 8	2 4 4	1 2 2	11 1	5 6½	2 9¼	1 7	1 2¼	0 9½	4¾
45 0 0	2 5 0	1 2 6	11 3	5 7½	2 9¾	1 7¼	1 2¼	0 9½	4¾
46 13 4	2 6 8	1 3 4	11 8	5 10	2 11	1 8	1 3	0 10	5
49 0 0	2 9 0	1 4 6	12 3	6 1½	3 0¾	1 9	1 3¾	0 10½	5¼
51 6 8	2 11 4	1 5 8	12 10	6 5	3 2½	1 10	1 4½	0 11	5½
53 13 4	2 13 8	1 6 10	13 5	6 8½	3 4¼	1 11	1 5¼	0 11½	5¾
56 0 0	2 16 0	1 8 0	14 0	7 0	3 6	2 0	1 6	1 0	6

NOTE.—If higher rates are required, refer to the column showing the HALF of required rate and double it: thus—required the rate per cwt. at 9*d.* per lb.;—refer to 4½*d.* lb. or £2 2*s.* per cwt. × 2 = £4 4*s.* per cwt. or 9*d.* per lb.

PROFIT AND DISCOUNT TABLES,

To Calculate from £1 to 6*d.* and from 2½ to 75 per Cent.

Rate per Cent.	Cost. £ s. d.	Nett Cost. s. d.	Return. £ s. d.
2½	1 0 0	19 6	1 0 6¼
	10 0	9 9	10 3
	5 0	4 10½	5 1½
	4 0	3 10¾	4 1½
	3 0	2 11	3 1
	2 0	1 11½	2 0½
	1 0	0 11¾	1 0½
	0 6	0 5¾	0 6¼
5	1 0 0	19 0	1 1 0¾
	10 0	9 6	10 6¼
	5 0	4 9	5 3¼
	4 0	3 9½	4 2½
	3 0	2 10½	3 2
	2 0	1 10¾	2 1¼
	1 0	0 11½	1 0¾
	0 6	0 5¾	0 6¼
7½	1 0 0	18 6	1 1 7½
	10 0	9 3	10 9¾
	5 0	4 7½	5 4¾
	4 0	3 8½	4 4
	3 0	2 9¼	3 3
	2 0	1 10¼	2 2
	1 0	0 11	1 1
	0 6	0 5½	0 6½
10	1 0 0	18 0	1 2 2¾
	10 0	9 0	11 1¼
	5 0	4 6	5 6¾
	4 0	3 7¼	5 4¼
	3 0	2 8½	3 4
	2 0	1 9½	2 2¾
	1 0	0 10¾	1 1¼
	0 6	0 5½	0 6¾
12½	1 0 0	17 6	1 2 10¼
	10 0	8 9	11 5¼
	5 0	4 4½	5 8½
	4 0	3 6	4 6¾
	3 0	2 7½	3 5¼
	2 0	1 9	2 3½
	1 0	0 10½	1 1¾
	0 6	0 5¼	0 6¾

Rate per Cent.	Cost. £ s. d.	Nett Cost. s. d.	Return. £ s. d.
15	1 0 0	17 0	1 3 6½
	10 0	8 6	11 9¼
	5 0	4 3	5 10½
	4 0	3 4¾	4 8½
	3 0	2 6½	3 6¼
	2 0	1 8½	2 4¼
	1 0	0 10¼	1 2
	0 6	0 5	0 7
17½	1 0 0	16 6	1 4 3
	10 0	8 3	12 1½
	5 0	4 1½	6 0¾
	4 0	3 3½	4 10¼
	3 0	2 5¾	3 7¾
	2 0	1 7¾	2 5
	1 0	0 10	1 2½
	0 6	0 5	0 7¼
20	1 0 0	16 0	1 5 0
	10 0	8 0	12 6
	5 0	4 0	6 3
	4 0	3 2½	5 0
	3 0	2 4¾	3 9
	2 0	1 7¼	2 6
	1 0	0 9½	1 3
	0 6	0 4¾	0 7½
22½	1 0 0	15 6	1 5 9¾
	10 0	7 9	12 10¾
	5 0	3 10½	6 5½
	4 0	3 1¼	5 2
	3 0	2 4	3 10½
	2 0	1 6½	2 7
	1 0	0 9¼	1 3½
	0 6	0 4¾	0 7¾
25	1 0 0	15 0	1 6 8
	10 0	7 6	13 4
	5 0	3 9	6 8
	4 0	3 0	5 4
	3 0	2 3	4 0
	2 0	1 6	2 8
	1 0	0 9	1 4
	0 6	0 4½	0 8

Rate per Cent.	Cost. £ s. d.	Nett Cost. s. d.	Return. £ s. d.
27½	1 0 0	14 6	1 7 7
	10 0	7 3	13 9½
	5 0	3 7½	6 10¾
	4 0	2 10¾	5 6¼
	3 0	2 2	4 1¾
	2 0	1 5½	2 9
	1 0	0 8¾	1 4½
	0 6	0 4¼	0 8¼
30	1 0 0	14 0	1 8 6¾
	10 0	7 0	14 3½
	5 0	3 6	7 1¾
	4 0	2 9½	5 8½
	3 0	2 1¼	4 3½
	2 0	1 4¾	2 10¼
	1 0	0 8½	1 5¼
	0 6	0 4¼	0 8½
32½	1 0 0	13 6	1 9 7½
	10 0	6 9	14 9¾
	5 0	3 4½	7 5
	4 0	2 8½	5 11
	3 0	2 0¼	4 5¼
	2 0	1 4¼	2 11½
	1 0	0 8	1 5¾
	0 6	0 4	0 9
33⅓	1 0 0	13 4	1 10 0
	10 0	6 8	15 0
	5 0	3 4	7 6
	4 0	2 8	6 0
	3 0	2 0	4 6
	2 0	1 4	3 0
	1 0	0 8	1 6
	0 6	0 4	0 9
35	1 0 0	13 0	1 10 9¼
	10 0	6 6	15 4½
	5 0	3 3	7 8½
	4 0	2 7½	6 1¾
	3 0	1 11½	4 7½
	2 0	1 3½	3 1
	1 0	0 7¾	1 6½
	0 6	0 4	0 9¼

PROFIT AND DISCOUNT TABLE,—*continued.*

Rate per Cent.	Cost.	Nett Cost.	Return.	Rate per Cent.	Cost.	Nett Cost.	Return.	Rate per Cent.	Cost.	Nett Cost.	Return.
	£ s. d.	s. d.	£ s. d.		£ s. d.	s. d.	£ s. d.		£ s. d.	s. d.	£ s. d.
37½	1 0 0	12 6	1 12 0	47½	1 0 0	10 6	1 18 1¼	65	1 0 0	7 0	2 17 1¾
	10 0	6 3	16 0		10 0	5 3	19 0½		10 0	3 6	1 8 6¾
	5 0	3 1½	8 0		5 0	2 7½	9 6¼		5 0	1 9	14 3½
	4 0	2 6	6 4¾		4 0	2 1¼	7 7½		4 0	1 4¾	11 5¼
	3 0	1 10½	4 9½		3 0	1 7	5 8½		3 0	1 0½	8 6¾
	2 0	1 3	3 2½		2 0	1 0½	3 9¾		2 0	0 8½	5 8½
	1 0	0 7½	1 7¼		1 0	0 6¼	1 10¾		1 0	0 4¼	2 10¼
	0 6	0 3¾	0 9½		0 6	0 3¼	0 11½		0 6	0 2	1 5¼
40	1 0 0	12 0	1 13 4	50	1 0 0	10 0	2 0 0	70	1 0 0	6 0	3 6 8
	10 0	6 0	16 8		10 0	5 0	1 0 0		10 0	3 0	1 13 4
	5 0	3 0	8 4		5 0	2 6	10 0		5 0	1 6	16 8
	4 0	2 4¾	6 8		4 0	2 0	8 0		4 0	1 2½	13 4
	3 0	1 9½	5 0		3 0	1 6	6 0		3 0	0 10¾	10 0
	2 0	1 2½	3 4		2 0	1 0	4 0		2 0	0 7¼	6 8
	1 0	0 7¼	1 8		1 0	0 6	2 0		1 0	0 3½	3 4
	0 6	0 3½	0 10		0 6	0 3	1 0		0 6	0 1¾	1 8
42½	1 0 0	11 6	1 14 9½	55	1 0 0	9 0	2 4 5¼	75	1 0 0	5 0	4 0 0
	10 0	5 9	17 4¾		10 0	4 6	1 2 2¾		10 0	2 6	2 0 0
	5 0	2 10½	8 8½		5 0	2 3	11 1¼		5 0	1 3	1 0 0
	4 0	2 3½	6 11½		4 0	1 9½	8 10¾		4 0	1 0	16 0
	3 0	1 8¾	5 2½		3 0	1 4¼	6 8		3 0	0 9	12 0
	2 0	1 1¾	3 5¾		2 0	0 10¾	4 5¼		2 0	0 6	8 0
	1 0	0 7	1 8¾		1 0	0 5½	2 2¾		1 0	0 3	4 0
	0 6	0 3½	0 10½		0 6	0 2¾	1 1¼		0 6	0 1½	2 0
45	1 0 0	11 0	1 16 4¼	60	1 0 0	8 0	2 10 0				
	10 0	5 6	18 2¼		10 0	4 0	1 5 0				
	5 0	2 9	9 1		5 0	2 0	12 6				
	4 0	2 2½	7 3¼		4 0	1 7¼	10 0				
	3 0	1 7¾	5 5½		3 0	1 2½	7 6				
	2 0	1 1¼	3 7¾		2 0	0 9½	5 .0				
	1 0	0 6½	1 9¾		1 0	0 4¾	2 6				
	0 6	0 3¼	0 11		0 6	0 2½	1 3				

RULES.—To find the NETT COST of Invoice Prices :—thus, at 4/0 per dozen, subject to 20 per cent. discount ; refer to Table 20 per cent. and opposite 4/0 in the "Cost" column will be found 3/2½, the nett cost price per dozen.

To ADD the REQUIRED PROFIT upon Invoice Price :—thus, at 10/0 per cwt. required 25 per cent. profit? Refer to Table 25 per cent. and opposite 10/0 in the "Cost" column will be found 13/4 in the "Return" column. For proof, if 25 per cent. be *deducted* from 13/4, it will leave 10*s.*, the invoice price.

To REDUCE SELLING price TO COST : suppose an article sold at 3/4 had 10 per cent. "return" added, what was the cost? Refer to 10 per cent. and opposite 3/4 in the "Return" column, will be found 3/0 in the "Cost" column.

BILLS AND PROMISSORY NOTES.

Payable in any other way than to Bearer on demand.

		Inland, or Foreign not drawn in Sets. £ s. d.	Foreign drawn in Sets. s. d.			Inland, or Foreign not drawn in Sets. £ s. d.	Foreign drawn in Sets. s. d.
Not exceeding	£5	0 0 1	---	Not exceeding	£500	0 5 0	1 8
,,	10	0 0 2	—	,,	750	0 7 6	2 6
,,	25	0 0 3	0 1	,,	1000	0 10 0	3 4
,,	50	0 0 6	0 2	,,	1500	0 15 0	5 0
,,	75	0 0 9	0 3	,,	2000	1 0 0	6 8
,,	100	0 1 0	0 4	,,	3000	1 10 0	10 0
,,	200	0 2 0	0 8	,,	4000	2 0 0	13 4
,,	300	0 3 0	1 0	And for every 1000 or part of 1000		0 10 0	3 4
,,	400	0 4 0	1 4				

Bills of Exchange and Promissory Notes drawn out of the United Kingdom, but payable or negociated within it, the same duty as Inland Bills; except above £500, for every £100 or part of £100, 1s.; denoted by adhesive Stamps.

INTEREST TABLE FROM £1 TO £500, AT FIVE PER CENT.

From One Day to Thirty.

£	1 day. s. d.	2 days. s. d.	3 days. s. d.	4 days. s. d.	5 days s. d.	6 days. s. d.	7 days. s. d.	8 days. s. d.	9 days. s. d.	10 days. s. d.	20 days. £ s. d.	30 days. £ s. d.
1	0 0	0 0	0 0	0 0	0 0	0 0¼	0 0¼	0 0¼	0 0¼	0 0¼	0 0 0½	0 0 0¾
2	0 0	0 0	0 0	0 0¼	0 0¼	0 0¼	0 0¼	0 0½	0 0½	0 0½	0 0 1¼	0 0 1¾
3	0 0	0 0	0 0¼	0 0¼	0 0¼	0 0½	0 0½	0 0¾	0 0¾	0 0¾	0 0 1¾	0 0 2¾
4	0 0	0 0¼	0 0¼	0 0½	0 0½	0 0¾	0 0¾	0 1	0 1	0 1¼	0 0 2½	0 0 3¾
5	0 0	0 0¼	0 0¼	0 0½	0 0¾	0 0¾	0 1	0 1¼	0 1¼	0 1½	0 0 3¼	0 0 [illegible]
6	0 0	0 0¼	0 0½	0 0¾	0 0¾	0 1	0 1¼	0 1½	0 1¾	0 1¾	0 0 3¾	0 0 5¾
7	0 0	0 0¼	0 0½	0 0¾	0 1	0 1¼	0 1½	0 1¾	0 2	0 2¼	0 0 4½	0 0 6¾
8	0 0¼	0 0½	0 0¾	0 1	0 1¼	0 1½	0 1¾	0 2	0 2¼	0 2½	0 0 5	0 0 7¾
9	0 0¼	0 0½	0 0¾	0 1	0 1¼	0 1¾	0 2	0 2¼	0 2½	0 2¾	0 0 5¾	0
10	0 0¼	0 0½	0 0¾	0 1¼	0 1½	0 1¾	0 2¼	0 2½	0 2¾	0 3¼	0 0 6½	0
20	0 0½	0 1¼	0 1¾	0 2½	0 3¼	0 3¾	0 4½	0 5¼	0 5¾	0 6½	0 1 1	0
30	0 0¾	0 1¾	0 2¾	0 3¾	0 4¾	0 5¾	0 6½	0 7½	0 8¾	0 9¾	0 1 7½	[illegible]
40	0 1¼	0 2½	0 3¾	0 5¼	0 6½	0 7¾	0 9	0 10½	0 11¾	1 1	0 2 2¼	[illegible]
50	0 1½	0 3¼	0 4¾	0 6½	0 8	0 9¾	0 11½	1 1	1 2¾	1 4¼	0 2 8¾	[illegible] 1½
60	0 1¾	0 3¾	0 5¾	0 7¾	0 9¾	0 11¾	1 1½	1 3¾	1 5½	1 7½	0 3 3¼	0 4 11
70	0 2¼	0 4½	0 6¾	0 9	0 11½	1 1½	1 4	1 6¼	1 8½	1 11	0 3 10	0 5 9
80	0 2½	0 5¼	0 7¾	0 10½	1 1	1 3¾	1 6¼	1 9	1 11½	2 2¼	0 4 4½	0 6 6¾
90	0 2¾	0 5¾	0 8¾	0 11¾	1 2¾	1 5¾	1 8½	1 11½	2 2½	2 5½	0 4 11	0 7 4¾
100	0 3¼	0 6½	0 9¾	1 1	1 4¼	1 7½	1 11	2 2¼	2 5½	2 8¾	0 5 5¾	0 8 2½
200	0 6½	1 1	1 7½	2 2¼	2 8¾	3 3¼	3 10	4 4½	4 11	5 5¾	0 10 11½	0 16 5¼
300	0 9¾	1 7½	2 5½	3 3¼	4 1¼	4 11	5 9	6 6¾	7 4¾	8 2½	0 16 5¼	1 4 7¾
400	1 1	2 2¼	3 3¼	4 4½	5 5¾	6 6¾	7 8	8 9	9 10¼	10 11½	1 1 11	1 12 10½
500	1 4¼	2 8¾	4 1¼	5 5¾	6 10	8 2½	9 7	10 11	12 3¾	13 8¼	1 7 4¾	2 1 1

COLONIAL AND FOREIGN RATES OF POSTAGE.

ABRIDGED FROM THE BRITISH POSTAL GUIDE.

COUNTRIES, &c. "c" denotes that prepayment is compulsory, it being in all other cases voluntary. "a" that an additional charge is made on delivery.	LETTERS: Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
ACCRA	0 6	0 6	1 0	1 0	1 6
Aden, via Marseilles, by British Packet	1 1	1 1	2 2	2 2	3 3
,, via Southampton.	0 9	0 9	1 6	1 6	2 3
Adrianople. See *Candia*.					
Aleppo, via Marseilles, by French Packet	c a 0 6	1 0	1 6	2 0	2 6
Alexandria, by British Packet, via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Southampton.	0 6	0 6	1 0	1 0	1 6
,, by French Packet, via Marseilles.	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Alexandretta, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	c a 0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	c a 0 8	1 2	1 10	2 4	3 0
Antigua	1 0	1 0	2 0	2 0	3 0
An[illegible] See *Candia*.					
[illegible] *Confederation*, via [illegible]pton	c a 1 0	1 0	2 0	2 0	3 0
[illegible]y French Packet	c a 0 8	1 4	2 0	2 8	3 4
[illegible] via Devonport	c 1 0	1 0	2 0	2 0	3 0
[illegible] *South*, via South[illegible]nd Suez	c 0 6	0 6	1 0	1 0	2 0
[illegible]a Marseilles and Suez	c 0 10	0 10	1 8	1 8	3 4
,, [illegible]a Panama	c a 0 6	0 6	1 0	1 0	2 0
See also [illegible]*oria* and *Western* [illegible]*stralia*.					
Austria, via France	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via Italy	0 8	1 4	2 0	2 8	3 4
Azores, via France	0 6	1 0	1 6	2 0	2 6
,, via Southampton.	0 6	0 6	1 0	1 0	1 6
BADAGRY	c a 0 6	0 6	1 0	1 0	1 6
Baden, via France	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
Bahamas	1 0	1 0	2 0	2 0	3 0
Bakau. See *Jassy*.					

COUNTRIES, &c. "c" denotes that prepayment is compulsory, it being in all other cases voluntary. "a" that an additional charge is made on delivery.	LETTERS: Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
Barbadoes	1 0	1 0	2 0	2 0	3 0
Bavaria, via France	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
Belgium (direct Mail)	0 3	0 3	0 6	0 6	0 9
,, via France	0 4	0 4	0 8	0 8	1 0
Belgrade, via France	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
Benha. See *Damanour*.					
Berbice	1 0	1 0	2 0	2 0	3 0
Bermuda, via Halifax	1 0	1 0	2 0	2 0	3 0
,, via New York	0 7	0 7	1 2	1 2	1 9
,, via St. Thomas	1 0	1 0	2 0	2 0	3 0
Beyrout, via Marseilles, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Birket-el-Sab. See *Damanour*.					
Birlad. See *Jassy*.					
Bolivia, via Southampton ... ,, by French Packet }	c a 2 0	2 0	4 0	4 0	6 0
Bonny	c a 0 6	0 6	1 0	1 0	1 6
Borneo, via Marseilles, by British Packet	c a 1 4	1 4	2 8	2 8	4 0
,, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	c a 1 4	1 4	2 8	2 8	4 0
Botuschany, via Belgium	0 7	0 7	1 2	1 2	1 9
,, via France and Austria	0 7	1 1	1 8	2 2	2 9
Bourgas. See *Candia*.					
Brazil, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	0 9	1 6	2 3	3 0	3 9
Bremen, via Belgium	0 6	0 6	1 0	1 0	1 6
British Columbia, via New York	0 7	0 7	1 2	1 2	1 9
Brunswick, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 8	1 4	2 0	2 8	3 4
Bucharest, via Belgium	0 7	0 7	1 2	1 2	1 9
,, via France and Vienna	0 7	1 1	1 8	2 2	2 9
Buenos Ayres, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	c a 0 8	1 4	2 0	2 8	3 4

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

COUNTRIES, &c. "*c*" denotes that prepayment is compulsory, it being in all other cases voluntary. "*a*" that an additional charge is made on delivery.		LETTERS. Not exceeding ¼ oz. s. d.	Above ¼ oz. and not exceeding ½ oz. s. d.	Above ½ oz. and not exceeding ¾ oz. s. d.	Above ¾ oz. and not exceeding 1 oz. s. d.	Above 1 oz. and not exceeding 1¼ oz. s. d.
CAIFA. See *Candia.*						
Cairo, by British Packet, via Marseilles		0 6	1 0	1 6	2 0	2 6
„ via Southampton.		0 6	0 6	1 0	1 0	1 6
„ via Belgium		0 11	0 11	1 10	1 10	2 9
„ via France and Austria		0 11	1 10	2 9	3 8	4 7
California. See *United States.*						
Cameroons	c a	0 6	0 6	1 0	1 0	1 6
Canada, via United States..		0 7	0 7	1 2	1 2	1 9
„ by Canadian Pkt.		0 6	0 6	1 0	1 0	1 6
Canary Islands, by Packet..		0 6	1 0	1 6	2 0	2 6
Candia, via Belgium and Trieste } „ via Belgium and Rutschuk }		0 9	0 9	1 6	1 6	2 3
„ via France and Austria		0 8	1 2	1 10	2 4	3 0
Canea, via Belgium and Trieste } „ via Belgium and Rutschuk }		0 9	0 9	1 6	1 6	2 3
„ via France and Trieste		0 8	1 2	1 10	2 4	3 0
Cape Coast Castle		0 6	0 6	1 0	1 0	1 6
Cape of Good Hope, via Devonport		1 0	1 0	2 0	2 0	3 0
Cape de Verd Islands		0 6	0 6	1 0	1 0	1 6
Cariacou		1 0	1 0	2 0	2 0	3 0
Carthagena (S. A.)	c a	1 0	1 0	2 0	2 0	3 0
Cavalla. See *Candia*						
Cayenne	c a	1 0	1 0	2 0	2 0	3 0
Ceylon, by British Packet, via Marseilles		1 1	1 1	2 2	2 2	3 3
„ via Southampton.		0 9	0 9	1 6	1 6	2 3
Chili	c a	2 0	2 0	4 0	4 0	6 0
China (except Hong Kong and Shanghai), via Marseilles, by British Packet		1 4	1 4	2 8	2 8	4 0
„ via Southampton.		1 0	1 0	2 0	2 0	3 0
„ by French Packet	c a	1 4	1 4	2 8	2 8	4 0
„ via St. Petersburgh, Kalgau, Pekin, Tientsin,	c	1 9	1 9	3 6	3 6	5 3
Urga	c	1 2	1 2	2 4	2 4	3 6
Chio. See *Candia*						
Coburg (*Saxe*), via Belgium		0 6	0 6	1 0	1 0	1 6
„ via France		0 6	1 0	1 6	2 0	2 6
Colon	c a	1 0	1 0	2 0	2 0	3 0

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Constantinople, via France and Vienna } „ via France and Trieste }		0 8	1 2	1 10	2 4	3 0
„ via Marseilles, by French Packet		0 6	1 0	1 6	2 0	2 6
„ via Belgium and Vienna } „ via Belgium and Trieste } „ via Belgium and Belgrade }		0 9	0 9	1 6	1 6	2 3
Costa Rica, via Panama	c a	1 0	1 0	2 0	2 0	3 0
Cuba	c a	1 0	1 0	2 0	2 0	3 0
Curaçoa		1 0	1 0	2 0	2 0	3 0
DAMANOUR, via Belgium		0 11	0 11	1 10	1 10	2 9
„ via France and Austria		0 11	1 10	2 9	3 8	4 7
For other routes, see *Egypt.*						
Damietta, via Belgium		1 2	1 2	2 4	2 4	3 6
„ via France and Austria		1 2	2 4	3 6	4 8	5 10
For other routes, see *Egypt.*						
Dardanelles, by French Packet, via Marseilles		0 6	1 0	1 6	2 0	2 6
„ via Belgium. See *Constantinople.*						
„ via France and Trieste		0 8	1 2	1 10	2 4	3 0
Demerara		1 0	1 0	2 0	2 0	3 0
Denmark, via Belgium		0 4	0 4	0 8	0 8	1 0
„ via France		0 9	1 6	2 3	3 0	3 9
Dominica		1 0	1 0	2 0	2 0	3 0
Durazzo. See *Candia*						
ECUADOR, via Southampton } „ by French Packet }	c a	2 0	2 0	4 0	4 0	6 0
Egypt, via Marseilles	c a	0 6	1 0	1 6	2 0	2 6
„ via Southampton (except *Alexandria*, *Cairo*, and *Suez*, which see).	c a	0 6	0 6	1 0	1 0	1 6
„ via Belgium	c a	0 9	0 9	1 6	1 6	2 3
„ via France and Austria	c a	0 8	1 2	1 10	2 4	3 0
FALKLAND ISLANDS		0 6	0 6	1 0	1 0	1 6
Fernando Po	c a	0 6	0 6	1 0	1 0	1 6
Fookschan. See *Jassy.*						

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

COUNTRIES, &c. "c" denotes that prepayment is compulsory, it being in all other cases voluntary. "a" that an additional charge is made on delivery.	LETTERS. Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
France and *Algeria*	0 4	0 8	1 0	1 4	1 8
Frankfort, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
GALATZ, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk; ,, via Hermannstadt and Czernowitz; ,, via Herrmanstadt	0 7	0 7	1 2	1 2	1 9
,, via France and Austria	0 7	1 1	1 8	2 2	2 9
Gallipoli, by French Packet, via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Belgium. See *Constantinople*.					
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Gambia	0 6	0 6	1 0	1 0	1 6
Gibraltar, via Southampton	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
Giurgevo, by French Packet, via Marseilles	c a 0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk; ,, via Kronstadt	0 7	0 7	1 2	1 2	1 9
,, via France and Austria	0 7	1 1	1 8	2 2	2 9
Gold Coast	c a 0 6	0 6	1 0	1 0	1 6
Goree, by French Packet	0 8	1 4	2 0	2 8	3 4
,, via Liverpool	c a 0 6	0 6	1 0	1 0	1 6
Greece, by French Packet	0 8	1 4	2 0	2 8	3 4
,, via Belgium and Trieste	0 10	0 10	1 8	1 8	2 6
,, via France and Trieste	0 10	1 4	2 2	2 8	3 6
,, via Italy	0 8	1 4	2 0	2 8	3 4
Grenada, by British Packet	1 0	1 0	2 0	2 0	3 0
,, by French Packet	1 0	1 0	2 0	2 0	3 0
Grey Town (St. Juan de Nicaragua)	c a 1 0	1 0	2 0	2 0	3 0
,, via Panama	c a 2 0	2 0	4 0	4 0	6 0
Guadaloupe, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	0 8	1 4	2 0	2 8	3 4
Guatemala, via Panama	c a 2 0	2 0	4 0	4 0	6 0
HAMBURG, via Belgium	0 6	0 6	1 0	1 0	1 6
Hanover, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 8	1 4	2 0	2 8	3 4
Hayti	c a 1 0	1 0	2 0	2 0	3 0

COUNTRIES, &c. "c" denotes that prepayment is compulsory, it being in all other cases voluntary. "a" that an additional charge is made on delivery.	LETTERS. Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
Heligoland, via Hamburg	0 8	0 8	1 4	1 4	2 0
Hesse, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
Holland, via Belgium	0 3	0 3	0 6	0 6	0 9
,, via France	0 6	1 0	1 6	2 0	2 6
Holstein. See *Prussia*.					
Honduras (British) via United States	1 0	1 0	2 0	2 0	3 0
,, (Foreign) via Panama	c a 2 0	2 0	4 0	4 0	6 0
HongKong, by British Packet	1 4	1 4	2 8	2 8	4 0
,, via Southampton	1 1	1 0	2 0	2 0	3 0
IBRAILA, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk; ,, via Hermannstadt	0 7	0 7	1 2	1 2	1 9
,, via France and Austria	0 7	1 1	1 8	2 2	2 9
India, via Marseilles, by British Packet	1 1	1 1	2 2	2 2	3 3
,, via Southampton	0 9	0 9	1 6	1 6	2 3
India (except Bombay) by French Packet	1 1	1 1	2 2	2 2	3 3
Ineboli. See *Tultscha*.					
Ionian Islands, via Italy	0 8	1 4	2 0	2 8	3 4
,, via Belgium and Trieste	0 10	0 10	1 8	1 8	2 6
,, via France and Trieste	0 10	1 4	2 2	2 8	3 6
Italy (except Papal States)	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 11	0 11	1 10	1 10	2 9
JAFFA, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Austria	0 8	1 2	1 10	2 4	3 0
Jamaica	1 0	1 0	2 0	2 0	3 0
Janina, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Austria	0 8	1 2	1 10	2 4	3 0
Japan	c a 1 4	1 4	2 8	2 8	4 0
,, via Southampton	1 0	1 0	2 0	2 0	3 0
Jassy, via Belgium	0 7	0 7	1 2	1 2	1 9
,, via France and Austria	0 7	1 1	1 8	2 2	2 9
Java, by British Packet	1 4	1 4	2 8	2 8	4 0
,, via Southampton	1 0	1 0	2 0	2 0	3 9

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

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COUNTRIES, &c.	LETTERS. Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
Jerusalem, by French Packet	*c a* 0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Austria	0 8	1 2	1 10	2 4	3 0
KAFERZAJAT. See *Damanour.*					
Kustendjie. See *Candia.*					
LABUAN, by British Packet	1 4	1 4	2 8	2 8	4 0
,, via Southampton.	1 0	1 0	2 0	2 0	3 0
Lagos (Africa)	*c* 0 6	0 6	1 0	1 0	1 6
,, (Turkey). See *Candia.*					
Larnica, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Latakia, by French Packet.	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	*c a* 0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	*c a* 0 8	1 2	1 10	2 4	3 0
Lauenburg, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 9	1 6	2 3	3 0	3 9
Liber[illegible]	*c* 0 6	0 6	1 0	1 0	1 6
Lippe Detmold, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
Lubeck, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
Luxemburg (Duchy of), via France	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
MADAGASCAR (St. Mary), by French Pkt.	0 8	1 4	2 0	2 8	3 4
,, (other parts).	*c a* 0 8	1 4	2 0	2 8	3 4
Madeira, by Packet direct } ,, do. via Lisbon }	0 6	0 6	1 0	1 0	1 6
Malta, via France	0 6	1 0	1 6	2 0	2 6
,, via Southampton.	0 6	0 6	1 0	1 0	1 6
Mansoura. See *Damietta*					
Martinique, via Southampton	*c a* 1 0	1 0	2 0	2 0	3 0
,, by French Packet	0 8	1 4	2 0	2 8	3 4
Mauritius, by French Pkt.	0 10	0 10	1 8	1 8	3 4
Mecklenburg-Schwerin and *Mecklenburg-Strelitz*, via Belgium	0 6	0 6	1 0	1 0	1 6
Mecklenburg-Strelitz, via France	0 8	1 4	2 0	2 8	3 4
Mersina, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	*c a* 0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	*c a* 0 8	1 2	1 10	2 4	3 0
Metelin or *Mytelene*, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium & Trieste } ,, via Belgium & Belgrade } ,, via Belgium & Rutschuk }	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Mexico	*c a* 1 0	1 0	2 0	2 0	3 0
Miholla. See *Samanud*					
Monte Video, via Southampton	*c a* 1 0	1 0	2 0	2 0	3 0
,, by French Packet	*c a* 0 8	1 4	2 0	2 8	3 4
Montserrat	1 0	1 0	2 0	2 0	3 0
Morocco (ex. Tangiers), via Southampton and Gibraltar	*c a* 0 6	0 6	1 0	1 0	1 6
,, via France and Gibraltar	*c a* 0 6	1 0	1 6	2 0	2 6
Mosquito Territory	*c a* 1 0	1 0	2 0	2 0	3 0
Mostar, via Belgium and Dalmatia	0 9	0 9	1 6	1 6	2 3
NATAL, via Devonport	1 0	1 0	2 0	2 0	3 0
Nevis	1 0	1 0	2 0	2 0	3 0
New Brunswick, via Halifax	0 6	0 6	1 0	1 0	1 6
,, via United States	0 7	0 7	1 2	1 2	1 9
Newfoundland	0 6	0 6	1 0	1 0	1 6
New South Wales, via Southampton and Suez	*c* 0 6	0 6	1 0	1 0	2 0
,, via Marseilles & Suez	*c* 0 10	0 10	1 8	1 8	3 4
New Zealand	*c* 0 6	0 6	1 0	1 0	2 0
,, via Marseilles & Suez	*c* 0 10	0 10	1 8	1 8	3 4
Nicaragua	*c a* 1 0	1 0	2 0	2 0	3 0
,, via Panama	*c a* 2 0	2 0	4 0	4 0	6 0
Norway, via Denmark	0 8	0 8	1 4	1 4	2 0
,, via Sweden	0 11	0 11	1 10	1 10	2 9
,, via France	1 2	2 4	3 6	4 8	5 10

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

COUNTRIES, &c.

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COUNTRIES, &c.	LETTERS. Not exceeding ¼ oz.	Above ¼ oz. and not exceeding ½ oz.	Above ½ oz. and not exceeding ¾ oz.	Above ¾ oz. and not exceeding 1 oz.	Above 1 oz. and not exceeding 1¼ oz.
	s. d.	s. d.	s. d.	s. d.	s. d.
Nova Scotia, via Halifax....	0 6	0 6	1 0	1 0	1 6
,, via United States	0 7	0 7	1 2	1 2	1 9
OLDENBURG, via Belgium..........	0 6	0 6	1 0	1 0	1 6
,, via France..........	0 8	1 4	2 0	2 8	3 4
Old Calabar..........	c a 0 6	0 6	1 0	1 0	1 6
Oregon. See *United States*					
PANAMA..........	c a 1 0	1 0	2 0	2 0	3 0
Papal States, via Mont Cenis.......... ,, by French Pkt. via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Belgium..........	0 11	0 11	1 10	1 10	2 9
Paraguay, via Southampton..........	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	c a 0 8	1 4	2 0	2 8	3 4
Penang. See *Singapore*.....					
Peru, via Southampton.... ,, by French Pkt...	c a 2 0	2 0	4 0	4 0	6 0
Philippine Islands, by British Pkt. via Marseilles....	c a 1 4	1 4	2 8	2 8	4 0
,, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
Philippopel, via Belgium and Belgrade..........	0 9	0 9	1 6	1 6	2 3
,, via France and Austria..........	0 8	1 2	1 10	2 4	3 0
Piatra. See *Jassy*..........					
Plojeshte. See *Botuschany*.					
Poland, via Belgium..........	0 9	0 9	1 6	1 6	2 3
,, via France..........	1 2	2 4	3 6	4 8	5 10
Porta Said, via Belgium....	1 4	1 4	2 8	2 8	4 0
,, via France and Austria..........	1 5	2 10	4 3	5 8	7 1
,, by French Packet	0 6	1 0	1 6	2 0	2 6
Porto Rico..........	c a 1 0	1 0	2 0	2 0	3 0
Portugal, via France..........	0 6	1 0	1 6	2 0	2 6
,, via Southampton	0 6	0 6	1 0	1 0	1 6
Prevesa. See *Philoppopel*.					
Prince Edward Island, via Halifax..........	0 6	0 6	1 0	1 0	1 6
,, via New York....	0 7	0 7	1 2	1 2	1 9
Prussia, via Belgium..........	0 6	0 6	1 0	1 0	1 6
,, Rhenish Prussia, via France.....	0 6	1 0	1 6	2 0	2 6
,, Other Parts, via France..........	0 8	1 4	2 0	2 8	3 4

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	s. d.	s. d.	s d.	s. d.	s. d.
QUEENSLAND, via Southampton and Suez..	c 0 6	0 6	1 0	1 0	2 0
,, via Marseilles and Suez..........	c 0 10	0 10	1 8	1 8	3 4
RETIMO. See *Candia*					
Reunion, by French Packet	0 8	1 4	2 0	2 8	3 4
Rhodes, by French Packet, via Marseilles..........	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste..........	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste..........	0 8	1 2	1 10	2 4	3 0
Roman. See *Jassy*.					
Roman States. See *Papal States*.					
Russia, via Belgium..........	0 9	0 9	1 6	1 6	2 3
,, via France..........	1 2	2 4	3 6	4 8	5 10
Rutschuk, via Belgium......	0 9	0 9	1 6	1 6	2 3
,, via France and the Danube... ,, via France and Vienna..........	0 8	1 2	1 10	2 4	3 0
ST. CROIX..........	a 1 0	1 0	2 0	2 0	3 0
St. Domingo..........	c a 1 0	1 0	2 0	2 0	3 0
St. Eustatius..........	c a 1 0	1 0	2 0	2 0	3 0
St. Helena, via Devonport.	1 0	1 0	2 0	2 0	3 0
St. Kitts..........	1 0	1 0	2 0	2 0	3 0
St. Lucia, by British Packet	1 0	1 0	2 0	2 0	3 0
,, by French Packet	1 0	1 0	2 0	2 0	3 0
St. Martin's..........	c a 1 0	1 0	2 0	2 0	3 0
St. Sophia, via Belgium and Belgrade..........	0 9	0 9	1 6	1 6	2 3
,, via France and Vienna..........	0 8	1 2	1 10	2 4	3 0
St. Thomas, via Southampton..........	a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	c a 1 0	1 0	2 0	2 0	3 0
St. Vincent (West Indies)...	1 6	1 0	2 0	2 0	3 0
St. Vincent (Cape de Verd) via Southampton..........	0 6	0 6	1 0	1 0	1 6
Salonica, by French Packet via Marseilles..........	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk.... ,, via Belgium aud Belgrade...... ,, via Belgium and Trieste.......	0 9	0 9	1 6	1 6	2 3

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

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	s. d.	s. d.	s. d.	s. d.	s. d.
Salonica, via France and Austria	0 8	1 2	1 10	2 4	3 0
Salvador, via Panama	*c a* 2 0	2 0	4 0	4 0	6 0
Samanud, via Belgium	1 0	1 0	2 0	2 0	3 0
,, via France and Austria	1 0	2 0	3 0	4 0	5 0
Samsoun, by French Packet	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk; ,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Austria	0 8	1 2	1 10	2 4	3 0
Sandwich Islands, via New York	*c a* 1 0	1 0	2 0	2 0	3 0
Santa Martha, via Southampton	*c a* 1 0	1 0	2 0	2 0	3 0
,, by French Packet	*c a* 1 0	1 0	2 0	2 0	3 0
Saxony, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 8	1 4	2 0	2 8	3 4
Schaumburg-Lippe, via Belgium	0 6	0 6	1 0	1 0	1 6
,, via France	0 6	1 0	1 6	2 0	2 6
Schleswig. See *Prussia*					
Scutari (Asia), via Belgium	*c a* 0 9	0 9	1 6	1 6	2 3
,, by French Packet	0 6	1 0	1 6	2 0	2 6
Senegal, by French Packet	0 8	1 4	2 0	2 8	3 4
,, via Liverpool	*c a* 0 6	0 6	1 0	1 0	1 6
Seres, via Belgium and Belgrade	0 9	0 9	1 6	1 6	2 3
,, via France and Belgrade	0 8	1 2	1 10	2 4	3 0
Servia (Belgrade excepted), via France and Austria	*c a* 0 6	1 0	1 6	2 0	2 6
Shanghai, by British Packet, via Marseilles	1 4	1 4	2 8	2 8	4 0
,, via Southampton	1 0	1 0	2 0	2 0	3 0
Seirra Leone	0 6	0 6	1 0	1 0	1 6
Singapore, via Marseilles, by British Packet	1 4	1 4	2 8	2 8	5 4
,, via Southampton	1 0	1 0	2 0	2 0	4 0
Sinope. See *Trebizond*.					
Smyrna, by French Packet, via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Spain, via France	0 6	1 0	1 6	2 0	2 6
Suez, via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Southampton	0 6	0 6	1 0	1 0	1 6
,, via Belgium	1 4	1 4	2 8	2 8	4 0
,, via France and Austria	1 5	2 10	4 3	5 8	7 1
Sulina. See *Trebizond*.					
Surinam	1 0	1 0	2 0	2 0	3 0
Sweden, via Denmark	0 6	0 6	1 0	1 0	1 6
,, via Stralsund	0 9	0 9	1 6	1 6	2 3
,, via France	1 2	2 4	3 6	4 8	5 10
,, via Hull	0 6	0 6	1 0	1 0	1 6
Switzerland, via France	0 5	0 10	1 3	1 8	2 1
,, via Belgium	0 8	0 8	1 4	1 4	2 0
Syria, via Marseilles, by French Packet	*c a* 0 6	1 0	1 6	2 0	2 6
TAHITI	*c a* 0 6	0 6	1 0	1 0	1 6
Tangiers, via Southampton and Gibraltar	0 6	0 6	1 0	1 0	1 6
,, via France and Gibraltar	0 6	1 0	1 6	2 0	2 6
Tanta. See *Damanour*					
Tasmania, via Southampton and Suez	*c* 0 6	0 6	1 0	1 0	2 0
,, via Marseilles and Suez	*c* 0 10	0 10	1 8	1 8	3 4
Tchernavoda. See *Candia*.					
Tchesme, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
Tenedos, via Belgium	0 9	0 9	1 6	1 6	2 3
,, via France and Trieste	0 8	1 2	1 10	2 4	3 0
Teneriffe, by Packet	0 6	1 0	1 6	2 0	2 6
Tobago	1 0	1 0	2 0	2 0	3 0
Tortola	1 0	1 0	2 0	2 0	3 0
Trebizond, by French Pkt.	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 9	0 9	1 6	1 6	2 3
,, via France and the Danube	0 8	1 2	1 10	2 4	3 0
Trinidad	1 0	1 0	2 0	2 0	3 0
Tripoli, (Syria), by French Packet, via Marseilles	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Trieste	*c a* 0 9	0 9	1 6	1 6	2 3
,, via France and Austria	*c a* 0 8	1 2	1 10	2 4	3 0
Tultscha, by French Packet	0 6	1 0	1 6	2 0	2 6

COLONIAL AND FOREIGN RATES OF POSTAGE—*continued.*

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	s. d.	s. d	s. d.	s. d	s. d
Tullscha, via Belgium and Rutschuk..... / ,, via Belgium and Kronstadt....	0 9	0 9	1 6	6 0	2 3
,, via France and Austria..........	0 8	1 2	1 10	2 4	3 0
Tunis, via Marseilles, by French Packet..............	0 6	1 0	1 6	2 0	2 6
Turkey, by French Packet..	c a 0 6	1 0	1 6	2 0	2 6
Turk's Island, via Southampton........................	1 0	1 0	2 0	2 0	3 · 0
UNITED STATES OF AMERICA.................	0 6	0 6	1 0	1 0	1 6
United States of Colombia ..	c a 1 0	1 0	2 0	2 0	3 0
Uruguay, via Southampton	c a 1 0	1 0	2 0	2 0	3 0
,, by French Packet	c a 0 8	1 4	2 0	2 8	3 4
VALONA. See *Candia.*					
Vancouver's Island, via New York	c a 0 7	0 7	1 2	1 2	1 9
Varna, by French Packet...	0 6	1 0	1 6	2 0	2 6
,, via Belgium and Rutschuk .... / ,, via Belgium and Trieste	0 9	0 9	1 6	1 6	2 3
,, via France and the Danube....	0 8	1 2	1 10	2 4	3 0

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	s. d.	s. d.	s. d.	s. d.	s. d.
Venetia. See *Italy.*					
Venezuela.......................	c 1 0	1 0	2 0	2 0	3 0
Victoria (Australia), via Southampton and Suez...	c 0 6	0 6	1 0	1 0	2 0
,, via Marseilles and Suez.............	c 0 10	0 10	1 8	1 8	3 4
Volo. See *Salonica.*					
WEST COAST, SOUTH AMERICA, via Southampton..................... / ,, by French Pkt..	c a 2 0	2 0	4 0	4 0	6 0
West Indies (British).........	1 0	1 0	2 0	2 0	3 0
Western Australia, via Southampton and Suez...	c 0 6	0 6	1 0	1 0	2 0
,, via Marseilles and Suez.............	c 0 10	0 10	1 8	1 8	3 4
Wurtemberg, via France.....	0 6	1 0	1 6	2 0	2 6
,, via Belgium	0 6	0 6	1 0	1 0	1 6
Whydah..........................	c a 0 6	0 6	1 0	1 9	1 6
YOKOHAMA, by French Packet.........................	1 4	1 4	2 8	2 8	4 (
ZAGASIK. See *Samanud.*					
Zifta. See *Samanud.*					

FOREIGN MAILS ARE MADE UP IN LONDON AND BECOME DUE AS FOLLOWS.

	Made up.	Due
AUSTRALIA generally and New Zealand, via Southampton	Every third Saturday	Every fourth Saturday.
Ditto, via Marseilles	Every fourth Friday	Every fourth Monday.
Ditto, via Panama	2d of each month	End of each month.
UNITED STATES	Morning every Tuesday, and even. every Tuesday, Wed. and Saturday	
CANADA, by Canadian Packet..................	Evening every Thursday	Every Friday.
WEST INDIES	2d and 17th each month	
BRAZIL, via Southampton	9th each month	First week in each month.
Ditto, by French Packet, via Bordeaux ...	Evening 23d and morning 24th of each month	22d each month.
CAPE OF GOOD HOPE	9th and 24th each month	
FRANCE, and the Continent generally	Daily morning and evening............	Twice daily.
MEXICO, via Southampton	2d each month	Once a month.
Ditto, by French Packet..........................	14th each month..........................	Once a month.
INDIAN MAILS.		
INDIA, via Marseilles, by British Packet ...	Every Friday evening	Every Monday.
Ditto, via Southampton	Every Saturday morning	Every Saturday.
Ditto (except Bombay), by French Packet	Evening of 17th and morning of 18th each month	7th each month.
CHINA MAILS.		
CHINA and JAPAN, via Marseilles	Evening every alternate Friday......	
Ditto, via Southampton	Morning every alternate Saturday..	
Ditto, by French Packet.........................	17th and morning 18th each month.	7th each month.
Ditto, via St. Petersburgh	Every Monday and Friday	

LONDON:
R. CLAY, SONS, AND TAYLOR, PRINTERS,
BREAD STREET HILL.